SECURITY SYSTEM OF
A RELATIONAL DATA BASE SYSTEM

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By
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CERTIFICATE

CERTIFIED that the work entitled SECURITY SYSTEM OF A RELATIONAL DATA BASE SYSTEM has been carried out under my supervision by Sri S. K. Goel and it has not been submitted elsewhere for a degree.

R. Sankar

Kanpur
July 19, 1978

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Kanpur
July 19, 1978

- Satish K. Goel

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ABSTRACT

This thesis deals with the design and implementation of a security mechanism for a relational data base. It also deals with removing a relation from the data base and reorganization of the data base.

It is a part of the project to implement a relational data base system on TDC-316. This thesis alongwith (Ref. 5) completes the implementation of functions falling in the domain of the data base administrator, i.e., controlling the overall view of the data, reorganization of the data base and ensuring security of the data base.

1. INTRODUCTION

One of the most important aspects of a data base system is to provide for adequate security of the data base. Since a data base generally contains the lump sum of data useful for any organization and various users keep interacting with the same, retrieving and updating the data placed in a central place, it is highly important that there be a mechanism for stopping illegal use of the data. Hence appropriate checks must be placed on every user of the data base. Moreover, there must be ways of checking out users who tend to use the system in an unauthorised manner and also indicate the same whenever asked to do so, so that defaulting users may be asked for proper explanations.

The description of a relational data base system and the various terms related to it as well as hardware and software tools available are very well described in a separate thesis (Reference 5). A data base as we know, is the collection of data useful for many applications and placed in a central place. The various applications extract from the data base their own views of data and application program are independent of the way data is organised in a data base. It is the responsibility of the data base management system to take care of any changes in the physical organization of the data base, to make the application programs immune to any changes taking place in the physical data base organization.

In a relational data base system, all the data is stored in terms of relations, i.e., flat files. A flat file is many similar occurrences of a record which consists of a number of fields.

The security system for a data base can be of varied complexity. The following discussion seeks to illustrate this point: Suppose that our data base contains PERSON-DETAILS as one of the relations as shown in Figure 1-1. A few security implementations (of increasing complexity

Personnel No. P#	Name N	Rank R	Pay P	Confidential Report CR

Figure 1-1.

could be as follows:

1. The user has access to all records of the relation if he is an authorised user, otherwise he has no access to the relation, i.e., either a user has authority to use a relation in enterity or not at all.
2. The user may see name, rank and pay of any person but may not see confidential report of any one. Thus the authority here is of field level i.e., either the user has some particular authority over a particular field of all records or he has no authority over that field for all records.

3. The user may see the name and rank of any person but may see his pay and confidential report only if his rank is higher than that of the person under consideration. Moreover a user may change the name if the record pertains to his own personnel number. Here we see that the user has some authority over a field for a particular record depending upon his qualification in relation to the other field values for that record. Here the users identity must reveal to the system his personnel number, rank etc., to be able to enforce this type of security scheme.

Moreover there can be other access parameters like location of the accessor, the time and day of the access and the maximum frequency with which an accessoris allowed to access the system etc.

This present thesis describes a security scheme of the field level of a relation as in No. 2 above. The five access privileges associated with a field are as below :

1. READ : In this case, the particular field value can be read for all records for processing.
2. OUTPUT : In this case the particular field value can be printed on a listing device for any record.
3. DELETE : In this case and record of a relation may be deleted if the accessor has DELETE right for all its fields.
4. MODIFY : In this case, the particular field value may be modified for any record.
5. INSERT : In this case, any no. of records can be inserted in a relation if the user has INSERT right over all its fields.

The access in the present system does not depend upon any parameters like location, time and day, frequency etc., because of hardware limitations (because the system has only one access location and there is no timer in the system).

In the last chapter, programs are described for removing a relation from the data base and a discussion on how to reorganise the data base.

2. PLANNING OF THE SECURITY SYSTEM

The previous chapter describes how a security system can be of varied complexity. The most primitive security scheme could be to allow or disallow any user from accessing the data base. Once a user is put through, he shall be able to perform any operations on the data in the data base. But such a scheme is not suitable for any practical data base system because a data base essentially contains data for various applications and we shall like any user to have only limited access to it, to perform the functions falling only in his application area. As the complexity of the security mechanism increases, there will be a corresponding increase in its cost in terms of software development effort and more prominently in terms of the fraction of total run time taken by the security mechanism to respond to any query.

The present security mechanism is as described below:

We know that in a Relational Data Base System, each relation consists of some fields, each identified by a field identification number. A field may be common to many relations, but its field identification number is the same for its occurrence in every relation. In the type of security system provided here, we shall build an authority vector or access rights vector for any user from the security codes supplied by him to the system. The ith element of this vector shall give the rights of the user related to the field with identification No. i. Since TDC-316 is a byte addressable

machine with 8 bit byte, it was decided that each element of the authority vector shall be stored in a byte, whose 8 bits shall be associated with the following rights. Figure 2-1 depicts this association.

1. READ
2. OUTPUT
3. DELETE
4. MODIFY
5. INSERT
6.)
7.) UNUSED
8.)

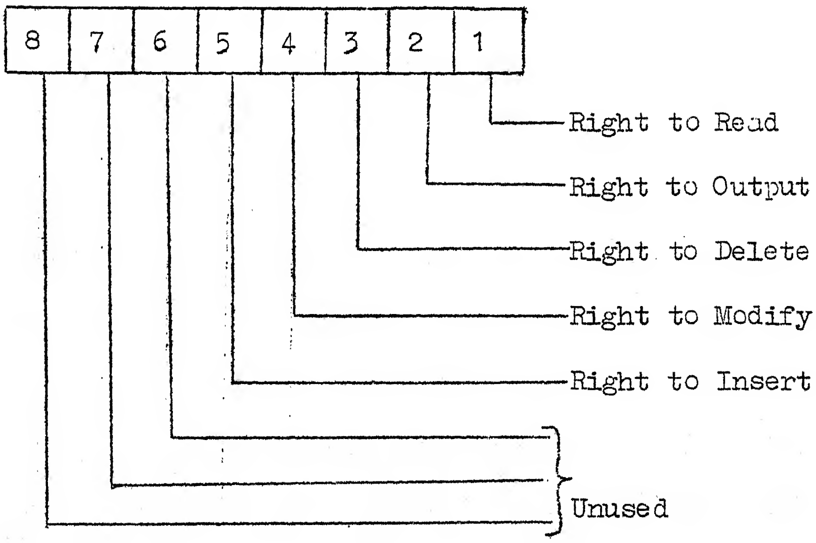


Figure 2-1: Rights associated with byte bits.

If a user has a particular right over a field, the corresponding bit shall be set, else it will be clear. Since the core memory available is very limited and all security codes and authority augmenting vectors cannot be profitably accomodated in core, it was decided to store the security codes and authority augmenting vectors in some area of the disk.

The present disk pack attached to TDC-316 has 203 cylinders. Each cylinder has 10 tracks (0 to 9) and each track is divided into 10 sectors (1 to 10). Each sector has a capacity to store 256 bytes (8 bits each).

Since the upper limit on the number of fields is 256 in the system designed, hence each authority augmenting vector can be acconodated in a sector of the disk.

In our system, we shall have two types of security codes:

1. FIRST SECURITY CODE: This is a code which helps the user to identify himself to the system. This helps the user to get access to the system. This is also called identification number of the user and is unique for each user.
2. AUTHORITY AUGMENTING SECURITY CODE: This code is used for augmenting the authority of the user. Each "Authority Augmenting Code" has an authority augmenting vector associated with it. A user may give more than one authority augmenting code to the system. The authority vector of a user is the logical OR of all those authority augmenting vectors for which he has given the corresponding authority augmenting security codes as input to the system.

Though authority vectors could be associated directly with "First Security Codes", i.e., user's identification numbers, but having two types of security codes as provided is useful on two counts -

1. Even if an unauthorised user breaks through the system by trying various first security codes till he succeeds in getting the right one (even though this is highly improbable), it is just impossible for him to give the correct authority augmenting security code in the first trial. Once he gives the wrong authority augmenting security code (after having succeeded in breaking the cardon of first security codes), the corresponding "First security code" is deleted from the group of valid first security codes and hence his access is again restricted to the system. It is in a way like a two level [illegible] protection, where any mistake at the second level puts the user out of the first level.

2. In general, many users (at the same level of management) shall have similar authority vectors. Therefore, we can merge their authority vectors into one and give them same authority augmenting security code whereas they have different first security codes. Since an authority augmenting vector takes much larger storage space (one sector) compared to that taken for storing only security code, we shall save in storage space on disk by merging authority augmenting vectors.

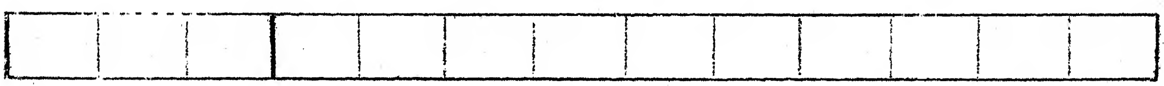
DATA STRUCTURES USED

1. <u>FIRST SECURITY CODES</u>

Since there are many first security codes (one for each user), therefore, to know whether a particular security code belongs to the set of valid codes, either we have to match it with each member of the set to see if it tallies with any one of these, or there should be

some information within the code itself, which indicates its position in the set. So we don't have to search through the entire set for a match but we only need to see whether security code at that particular position matches or not. It was decided that the first three digits of the code shall indicate its position within the array of codes. The length of the rest of the code was chosen to be 10 digits, thus giving a 13 digit security code as shown in Figure 2-2.

The internal storage of each security code is 5 bytes in the format shown in Figure 2-3. The lower four bytes contain the binary equivalent of the number generated from the lower 10 digits of the security code. Bits of the 5th byte contain information telling whether this security code exists or not, whether it was illegally used and if yes in what manner as indicated in Figure 2-3.



First three digits tell the position of the security code in the security codes table.

These lower 10 digits are converted into a number for internal storage taking four bytes.

Figure 2-2. Format of Security Codes.

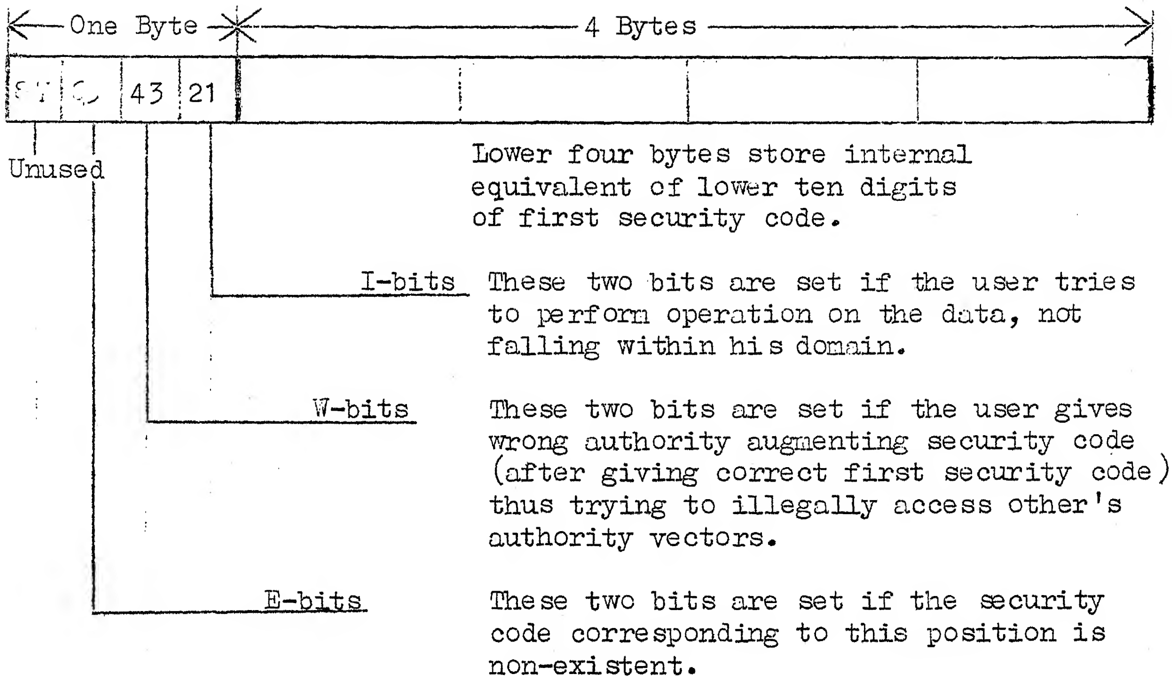


Figure 2-3: Format for internal storage of first security codes.

Since one security code takes five bytes for internal storage, so the number of security codes that can be accomodated in one sector of the disk is $\lfloor 256/5 \rfloor = 51$.

To keep track of the sectors which store first security codes, we have a table shown in Figure 2-4 called "FIRST Security Codes" TABLE DIRECTORY" (FSECDC). As can be seen from the figure, each row of this table takes 14 bytes. Since this table itself is placed in a sector of the disk, so maximum number of rows of this table is $\lfloor 256/14 \rfloor = 18$. Since one row contains information about one sector (which may contain maximum of 51 security codes), so maximum number of First-Security-Codes that can be issued is equal to 18x51 = 918, which is a fairly large number and sufficient for all practical applications.

The columns of "First Security Codes' Table Directory" have the following meanings:

← 14 Bytes →

Row	Cylinder No. CYLDRF	Sector & Surface No. SECTRF	10 digits Random No. RDND
1	2 Bytes	2 Bytes	10 Bytes
2			
3			
4			
⋮			
15			
16			
17			
18			

The ith row of the table contains relevant information for security codes whose first 3 digit number lie between ix51-50 and (ix51)

Figure 2-4: First Security Codes' Table Directory (FSECDC)

<u>CYLDRF:</u> This column contains the cylinder number of the disk where the sector containing information about the corresponding group of codes is stored. A non-existing entry in this table is indicated by a -ve value of this field for that particular row.

<u>SECTRF:</u> This column contains the surface number and sector number of the sector of the disk containing information about the corresponding group of codes. These two values are packed into one word in the form shown in Figure 2-5, which is the same as that used by the disk controller.

15 – 9	8 – 5	4 – 0
Unused	Surface No. (0-9)	Sector No. (1-10)

Figure 2-5: Format for putting sector No. & Surface No. in one word.

RDND: This column stores a 10-digit random number for each group of 51 security codes (i.e., one sector). This is used to generate another number from the lower 10 digits of the security code using the routine (WORBLE). The idea is to make the internal number stored on the disk different from the corresponding first security code so that it may be extremely difficult, if not impossible, for any person to compute the first security code of some one else, after he has somehow (though it shall not be possible through normal channels as the disk shall also be protected) read the internally stored security code from the disk. Since this routine WORBLE is changable at the discretion of the DBA, it will be very difficult to know, what transformation this routine is applying on the security code to generate another 10 digit number which is converted into its binary value for internal storage, by the routine GIVSEC.

The only information that is maintained in core, regarding the first security codes, is the address of the sector containing "First Security Codes' Table Directory". There are two variables (one word each) for keeping track of this information:

ISECYL : contains cylinder number of the disk where "First Security Codes' Table Directory" (FSECDC) is stored.

ISECTR : contains sector and surface number of the disk where FSECDC is stored (in the format shown in Figure 2-5).

ISECYL = 196
ISECTR = 35 ---

–	001	003
15 9	8 5	4 0

FSECDC

Sector of disk in cylinder No. 196, surface No. 1, sector No. 3

	CYLDRRF	SECTRF	RDND
1	196	39	1 9 8 6 5 4 3 2 5 7
2	-1	–	–
3	-1	–	–
4	197	01	7 3 2 5 8 6 3 2 1 8
5	-1	–	–
6	-1	–	–
7	-1	–	–
8	-1	–	–
9	-1	–	–
10	-1	–	–
11	197	05	1 3 2 5 4 9 7 8 3 6
12	-1	–	–
13	-1	–	–
14	-1	–	–
15	-1	–	–
16	-1	–	–
17	-1	–	–
18	-1	–	–
	← 2 Bytes →	2 Bytes	← 10 Bytes →

Cyl. No. 196
Surface No. 1
Sector No. 7.

	One byte	Four bytes
1	48	–
2	⋮	⋮
15	48	–
16	0	1 5 9 6 8 2 3 4 5 7
17	48	–
	⋮	⋮
27	48	–
28	03	2 3 0 5 8 2 6 4 1 7
29	0	0 6 8 3 0 0 5 0 2 8
30	48	–
	⋮	⋮
43	48	–
44	0	3 2 5 8 8 6 6 9 7 3
45	48	–
	⋮	–
51	48	–

Cyl. 197
Surface 0
Sector 1

1	48	–
	⋮	⋮
15	48	–
16	0	1235407231
17	12	0865324321
18	48	–
	⋮	⋮
51	48	–

Sec. code 016...17

Sec. code =044

Cyln. 197
Surface 0
Sector 5

	48	–
	⋮	⋮
	48	–
29	0	0783216541
	48	–
	⋮	⋮
	48	–

Sec. Code 539..

Figure 2-6: (An Instance) of First Security Codes' Tables.

Figure 2-6 shows, how an instance of these tables may look at any moment. This also depicts how the mapping of a security code to its internal stored equivalent is done starting from ISECYL and ISECTR. In the Figure, -1 in the CYLDRF field indicates a non-existing entry. We see that in the figure only two entries exist and contents of these sectors show that only 7-security codes exist, out of which two have been used illegally and hence are unusable.

2. AUGMENTING SECURITY CODES

The augmenting security code also has a length of 13 digits with the first 3 digits giving information regarding the position of a code in the table of authority augmenting security codes.

The internal storage for each security code is 10 bytes as shown in the format in Figure 2-7.

2 Bytes	4 Bytes	4 Bytes
0 – 1	2 – 5	6 – 9
These two bytes contain the cylinder No.	These 4 bytes contain a scrambled no. generated from the 9-bit surface and sector No. using routine VORBLE.	These four bytes contain the internal equivalent of the lower 10 digits of the authority augmenting security code.

Figure 2-7: Format for Internal Storage of Authority Augmenting Security Code.

Again 4 bytes are taken up by the binary equivalent of the internal number generated from the lower 10 digits of the security code, as in the case of first security codes. The remaining six bytes are taken by two fields given below:

Cylinder No. (2 Bytes): We know that there is one authority augmenting vector stored on the disk corresponding to each existing authority augmenting security code. This field gives the cylinder number of the disk which contains the corresponding authority augmenting vector in one of its sectors. A -ve value of this field indicates that the security code corresponding to this position of the table has not been defined by the DBA.

Sector and Surface No. (4-Bytes): This field stores the surface and sector number of the disk (with cylinder number indicated by cylinder number field) where the corresponding authority augmenting vector is stored. Though 2 bytes are enough for this field (in the format shown in Figure 2-5), the reason for providing four bytes is as follows -

As the contents of authority augmenting vectors are of crucial importance, we would like it to be impossible for any intruder to be able to know where his authority augmenting vector is stored and to change the contents of any authority augmenting vector to give him access to the areas prohibited to him. Therefore, instead of storing the surface and sector number of the authority augmenting vector directly, we scramble it to produce another artificial number of 4 bytes from this 9-bit information using a routine (VORBLE) and put its value on the disk. There shall be a routine (DVORBL) to change this four byte value back to the same 9 bits of information. These two routines (VORBLE) and (DVORBL) are changable at the discreation of the DBA but should be such that for each 9-bit input to routine (VORBLE), the 4-byte output produced by it should be such that when fed to the routine (DVORBL), it produces as output the same pattern of 9 bits which was given as input to routine (VORBLE).

One thing to be noted is that there is no information stored regarding wrongful use of any authority augmenting security code. This information is purposeful only for the first security codes so that the users trying to use the system in any illegal manner may be marked and asked for explanations.

With 10 bytes of internal storage being needed for each Authority Augmenting Security Code, the number of codes about which information can be maintained in a sector of the disk is $\lfloor 256/10 \rfloor = 25$. Again to keep track of the sectors which store authority augmenting security codes, we have an AUGMENTING SECURITY CODES' TABLES DIRECTORY (ASECDC) as shown in Figure 2-8. This has exactly the same format as FSECDC shown in Figure 2-4 and the fields have exactly similar explanations. It is also accomodated in a sector of the disk and has maximum of 18 entries. So maximum number of authority augmenting security codes that can be issued is 18 x 25 = 450.

Again the only information that is maintained in core, regarding authority augmenting security codes, is the address of the sector containing Augmenting Security Codes' Table Directory. The two variables (one word each) holding this information are as below -

ASECYL: contains the cylinder number of the disk where the Augmenting Security Code's Table Directory (ASECDC) is stored.

ASECTR: contains the surface and sector number of the disk where ASECDC is stored (in the format of Figure 2-5).

← 14 bytes →

Cylinder No. CYLDRA	Sector & Surface No. SECTRA	10-digit Random No. RANDA
2 bytes	2 Bytes	10 Bytes
1		
2		
3		
4		
.		
.		
.		
15		
16		
17		
18		

Figure 2-8: Augmenting Security Codes' Table Directory (ASECDC)

Figure 2-9 shows an instance of authority augmenting security codes tables with only 3 authority augmenting security codes existing.

Since the DBA (data base administrator) has also to approach the system through a "first security code" (no separate provision being made for him), to identify the first security code of the DBA, we have a variable DBSC.1 (one word) which stores the first three digits (converted to equivalent binary form) of DBA's first security code.

<u>ALGORITHM FOR SECURITY CHECKING</u>

When a user indicates his interest in using the data base system, only a small part of the programs get loaded from disk into main memory. This part of the program asks the user to give his security codes and then if found valid, it loads the appropriate programs depending upon whether the user is a Data Base Administrator or some other user. If user is the Data Base Administrator, then the programs loaded are as below:

ASECYL = 200

ASECTR = 03

-	0	3
9 8	5 4	0

ASECDC

Sector of the Disk in Cylinder No. 200 Surface No. 0 Sector No. 3

	CYLDRA	SECTRA	RDNDA
1	-1	-	-
2	-1	-	-
3	197	08	5678432109
4	-1	-	-
5	-1	-	-
6	-1	-	-
7	-1	-	-
8	-1	-	-
9	-1	-	-
10	-1	-	-
11	-1	-	-
12	-1	-	-
13	-1	-	-
14	-1	-	-
15	-1	-	-
16	-1	-	-
17	-1	-	-
18	-1	-	-

Cylinder No.197, Surface No. 0, Sector No. 8

	Cylinder No.	Sector & Surface No. (Scrambled value)	Security Code
1	-1	-	
2	-1	-	
3	198	-	
4	-1	Scrambled value of 69(2,5)	1987612345
⋮	⋮		⋮
16	-1	-	-
17	196	Scrambled value of 100(3,4)	1765431829
18	-1	-	-
19	-1	-	-
20	199	Scrambled value of 04(0,4)	1976523498
⋮	⋮		⋮
25	-1	-	-

Cylinder No. 198
Surface No. 2
Sector No. 5

Authority vector for Sec. code = 105.....

Cylinder No. 196
Surface No. 3
Sector No. 4

Auth. Aug. Vec. for Sec. Code = 119....

Cylinder No. 195
Surface No. 0
Sector No. 4

Auth. vec. of sec. code = 122....

Figure 2-9: An Instance of Authority Augmenting Security Codes' Tables.

1. Program for deleting any security codes.

1. 2. Programs for changing any security codes or authority vectors.

3. Program for inserting new security codes.

2. 4. Program for printing of the security codes tables.

3. 5. Program for initializing the security codes tables.

4. 6. Program for building of the data base (setting up new relations)

5. 7. Program for removing a relation from the data base.

Otherwise the programs loaded are as below -

1. Program for retrieving any information from the data base.

2. Program for updating information in the data base.

3. Other routines and data used by above two programs.

The flowchart of the program which asks for security codes and loads appropriate programs is shown in Figure 2-10. The following paragraph supplements the information given in the flowchart.

The initial data is the value of ISECYL, ISECTR, ASECYL, ASECTR, DBSC.1, data which tells from where in disk various programs like update, retrieve, security programs, build programs etc. are to be loaded and to which areas of main memory they go. (Since the object program are in absolute machine languageform). Only the assembly language equivalent of flowchart (Figure 2-10) is incorporated under KDM with code "DB". This program does rest of the job itself.

The program for retrieval and updating are developed under the separate theses (Reference 1 and 7). The present thesis along with (Ref. 5) where programs for building the data base are described completes the functions carried out by the DBA. Flowchart in Figure 2-11

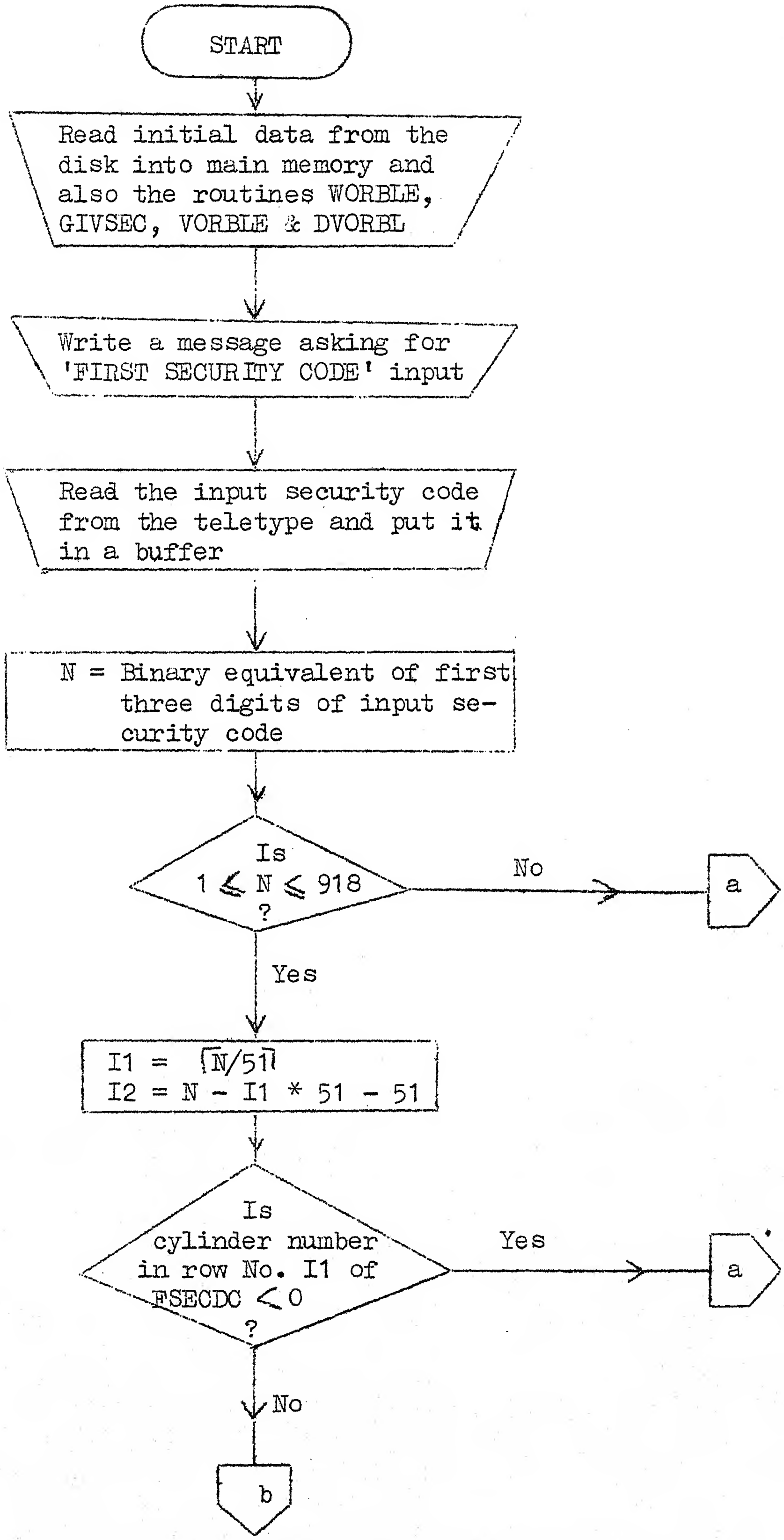


Figure 2-10: Continued on next page.

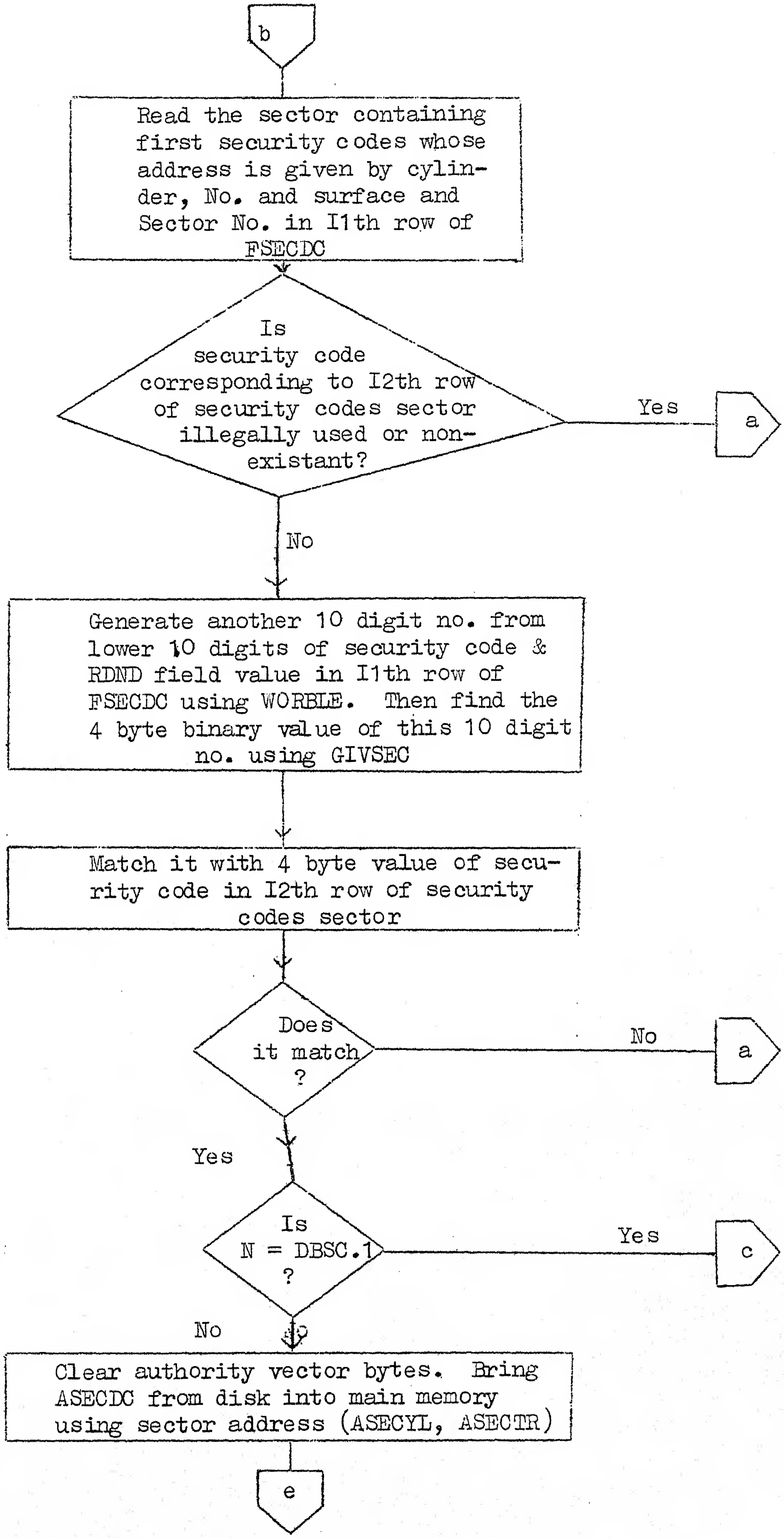


Figure 2-10: Continued on next page.

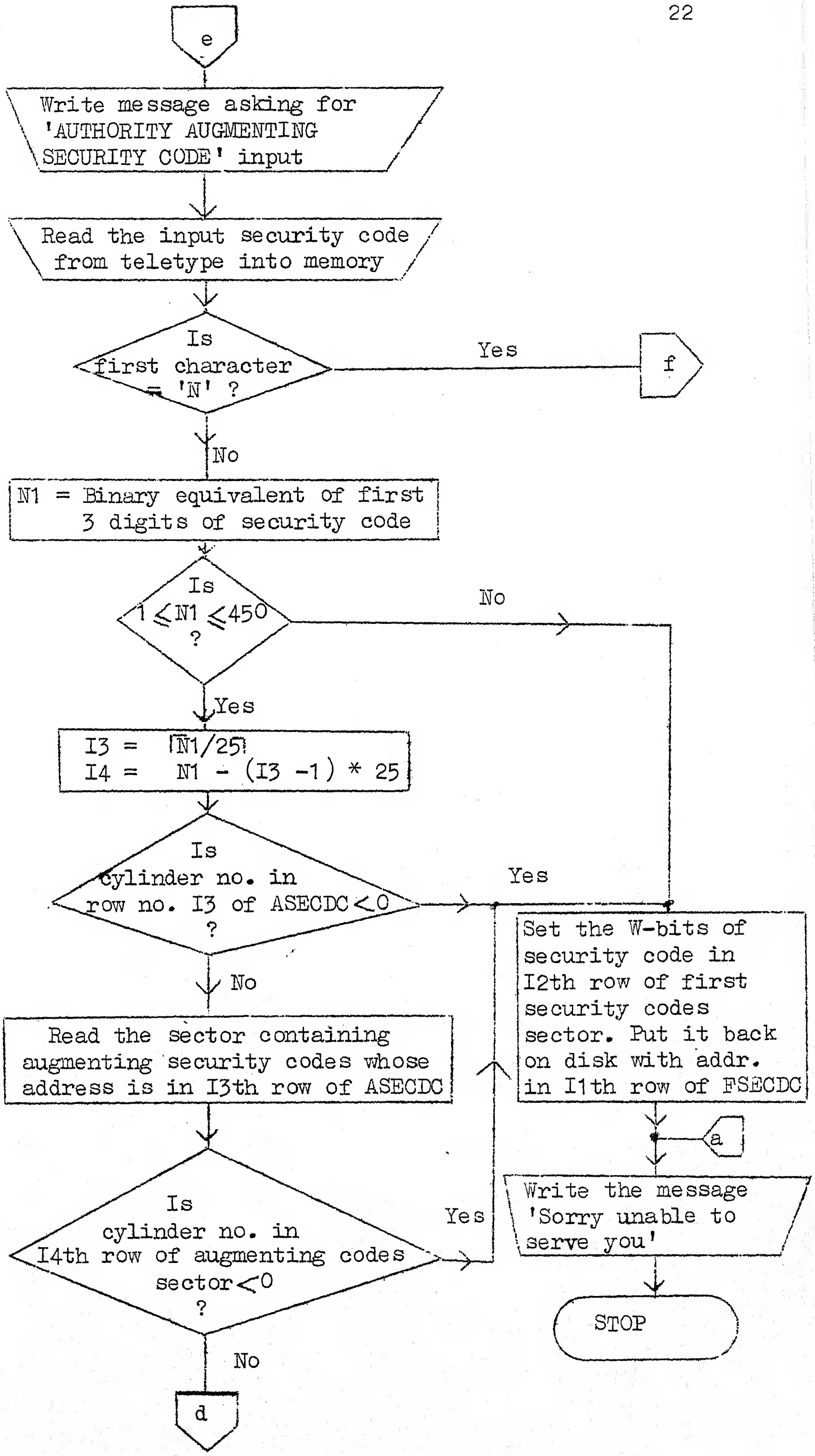


Figure 2-10: Continued on next page.

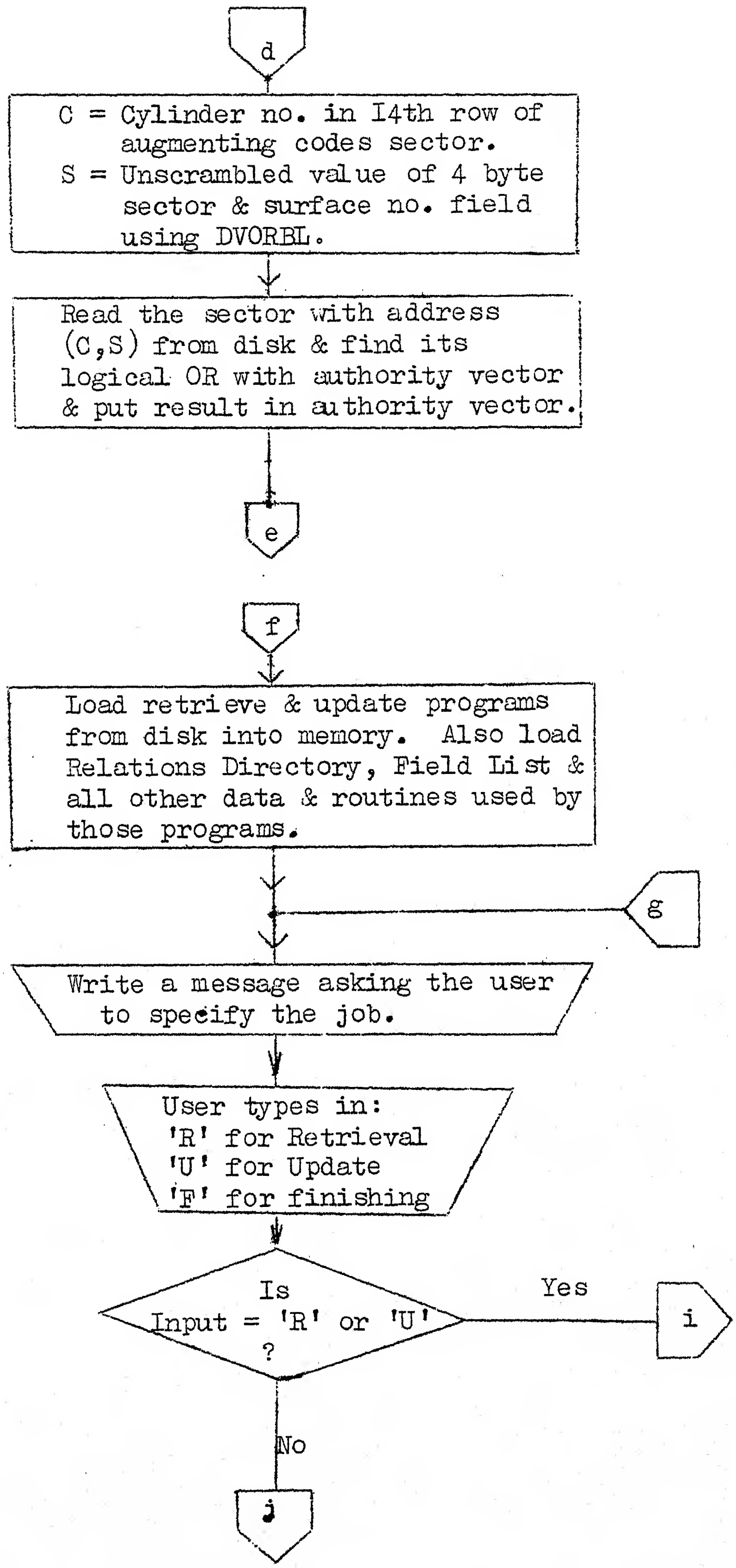


Figure 2-10: Continued on next page.

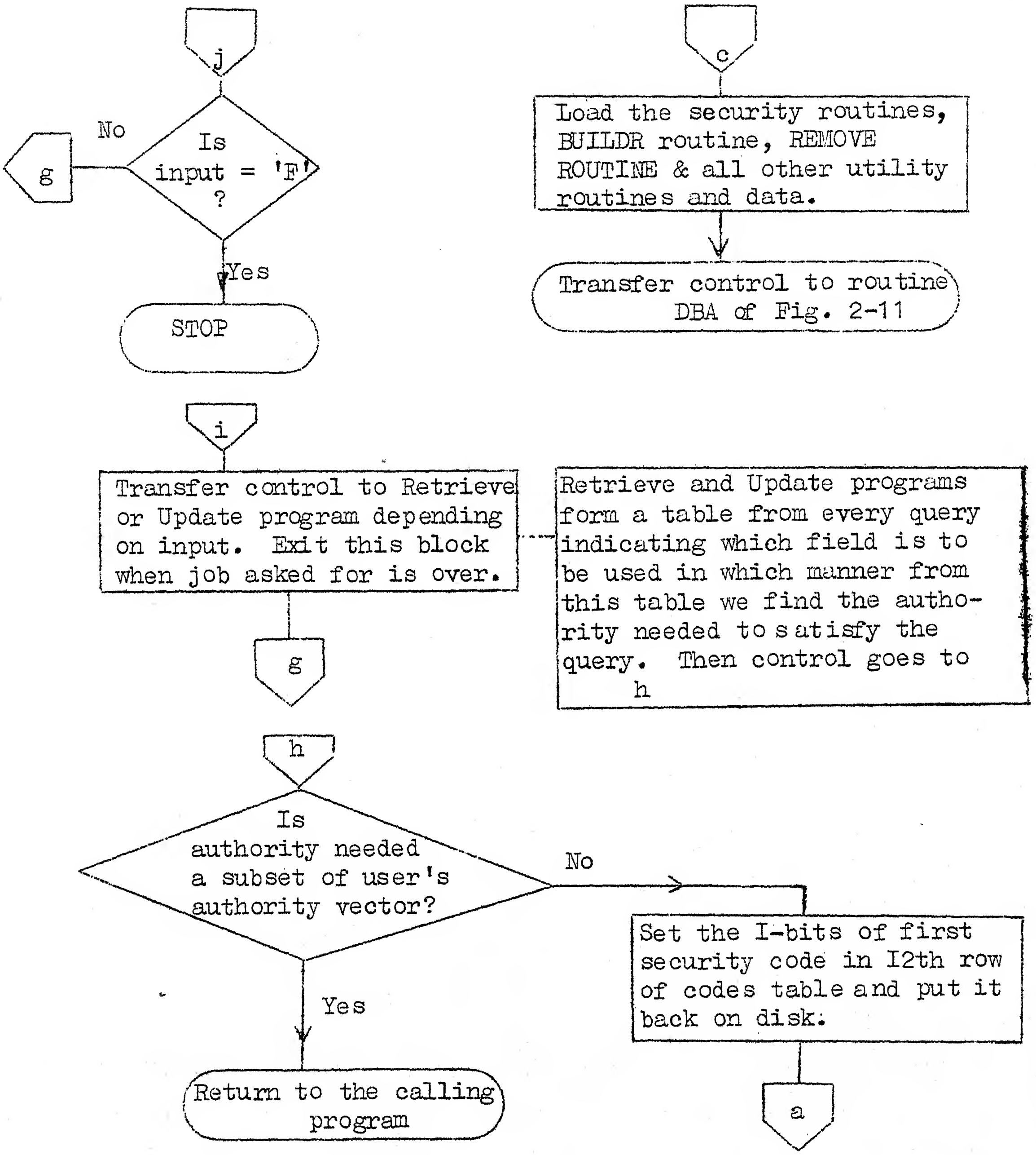


Figure 2-10: Flowchart for checking Security Codes.

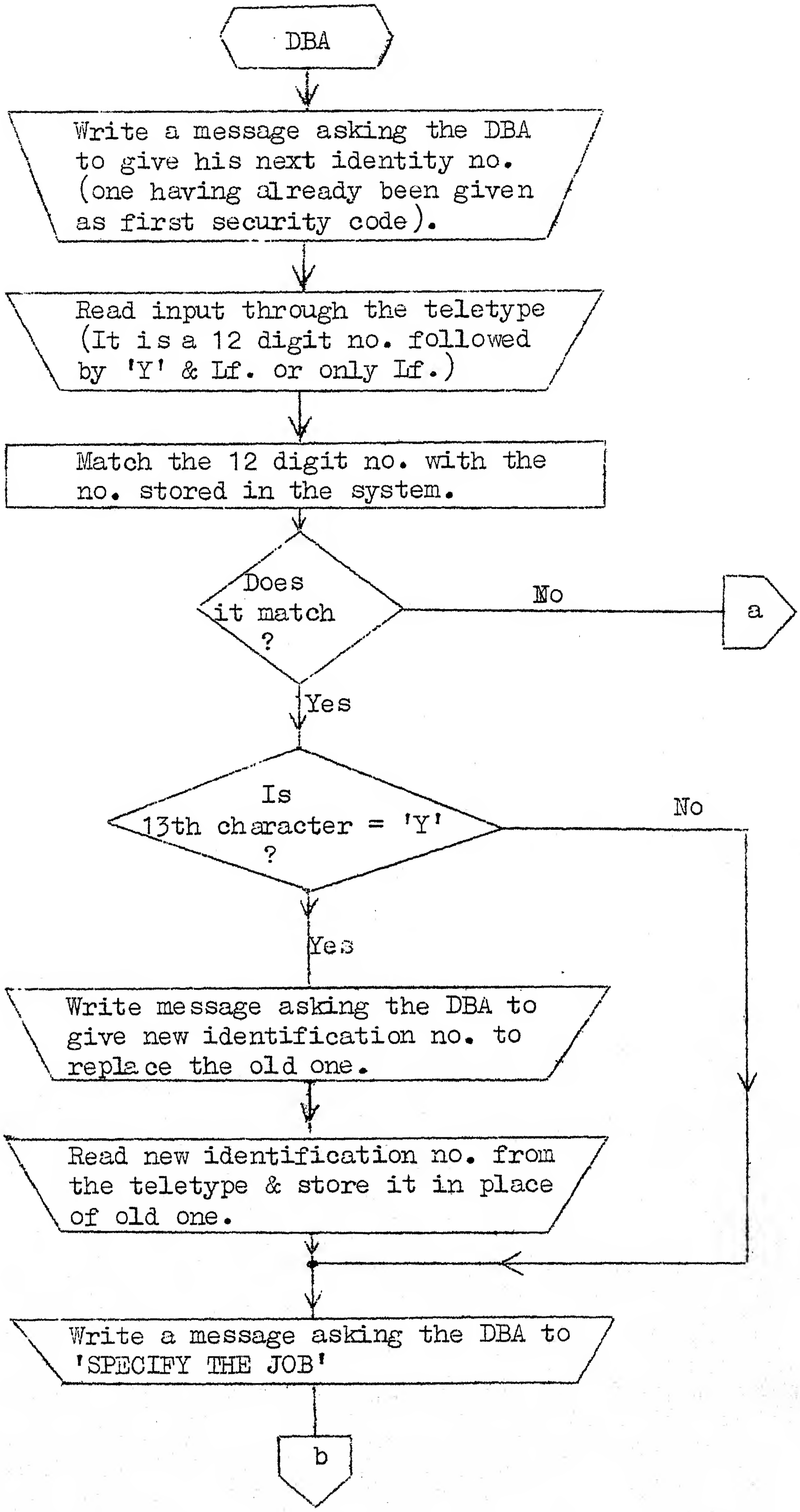


Figure 2-11. Continued on next page.

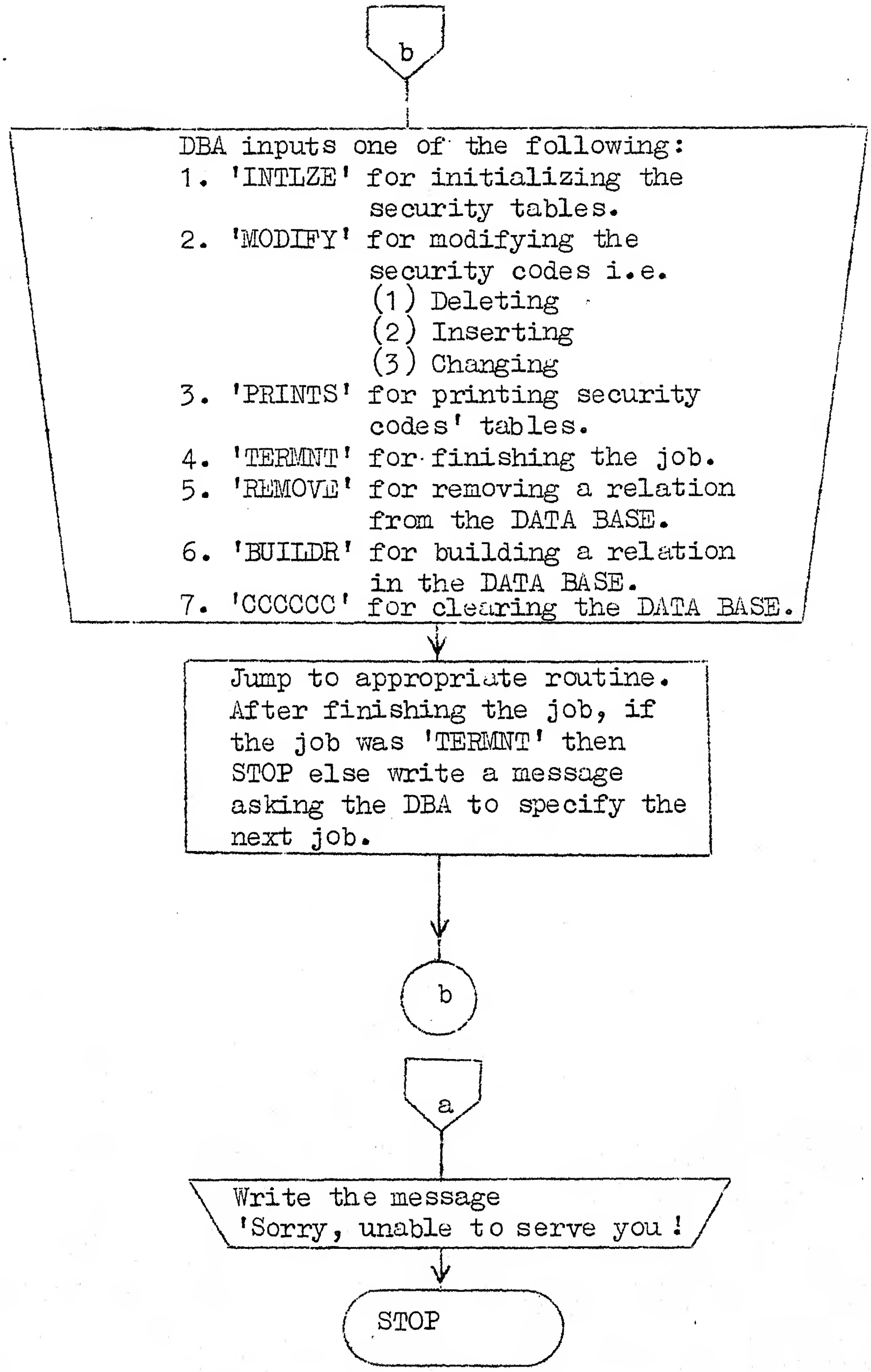


Figure 2-11: Flow chart for processing DBA's request.

shows the path that the DBA has to go through to carry out his task. The flowcharts for these tasks are detailed in later chapters in the following sequence.

Chapter 3 - Initialising the Security Tables

Chapter 4 - Modifying the Security Tables.

Chapter 5 - Printing the Security Tables.

Chapter 6 - Removing a Relation.

3. INITIALISING THE SECURITY TABLES

As described in the previous chapter, there are two types of security codes -

1. First Security Codes.

2. Authority Augmenting Security Codes.

Both these security codes involve two types of tables for internal storage as seen in last chapter which are -

1. Codes'Table Directory

2. Codes Table.

Codes' Table Directory gives pointer to the sector of the Codes Table in appropriate sequence depending upon the group of codes that the sector contains. Initialisation routine clears all the authority augmenting security codes from the tables and also clears all the first security codes except the first security code of the DBA which is retained to allow him continued access, for adding new security codes to initialized tables.

Initialization is essential when the DBA wants to change any of the routines WORBLE, VORBLE and DVORBLE etc., because now the internally stored security codes and surface and sector number in ASECDC will be computed using new routines and therefore the tables must be initialised and filled all over again. Also in this case, when the routines are changed, internally stored first security code of the DBA has also to be changed to the value produced by these new routine while acting on DBA's first security code and this is done at the same time when routines are changed.

Since all the security codes and authority augmenting vectors are stored on the disk, some space needs to be assigned on the disk for the purpose of storing these. Because maximum of 1+18+1+18+450 = 488 sectors of security space may be needed, we reserve 5 cylinders (500 sectors) on the disk and call this reserved space as "Disk Security Space". To manage the disk security space, we store the status of each sector (free or full) in a bit and a 496 bit vector (an array of 31 words starting from the address BITMP) reflects the status of disk security space at any time. The routine ALOCTS allocates a sector of the disk security space, makes its status bit 1 and return the address of this sector to the calling program. The routine RELSEC releases a sector of disk security space with sector address given by the calling program by clearing its status bit. The program for these two routines appear in the Program Listings.

INITIALIZATION ALGORITHM

This algorithm in the form of a flowchart is shown in Figure 3-1. The equivalent program appears in the Program Listings. It deletes all security codes except DBA's first security code from the security tables. It also changes the disk storage addresses of FSECDC and ASECDC by allocating them new sectors and releasing the sectors previously held by them, thus making the positions of these tables changable. After initialisation, new security codes can be added using the MODIFY routine in the manner explained in the next chapter.

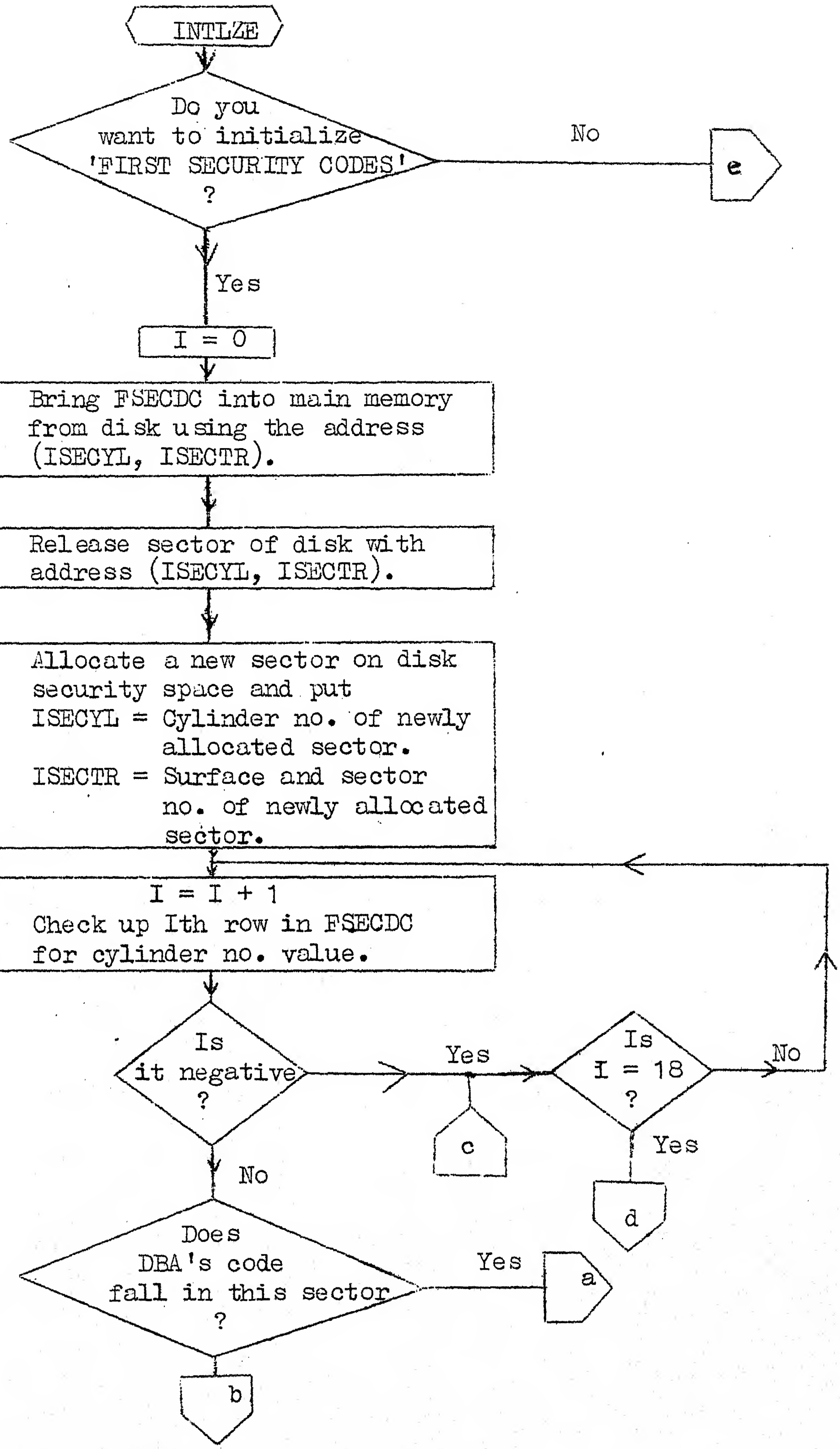


Figure 3-1: Continued on next page.

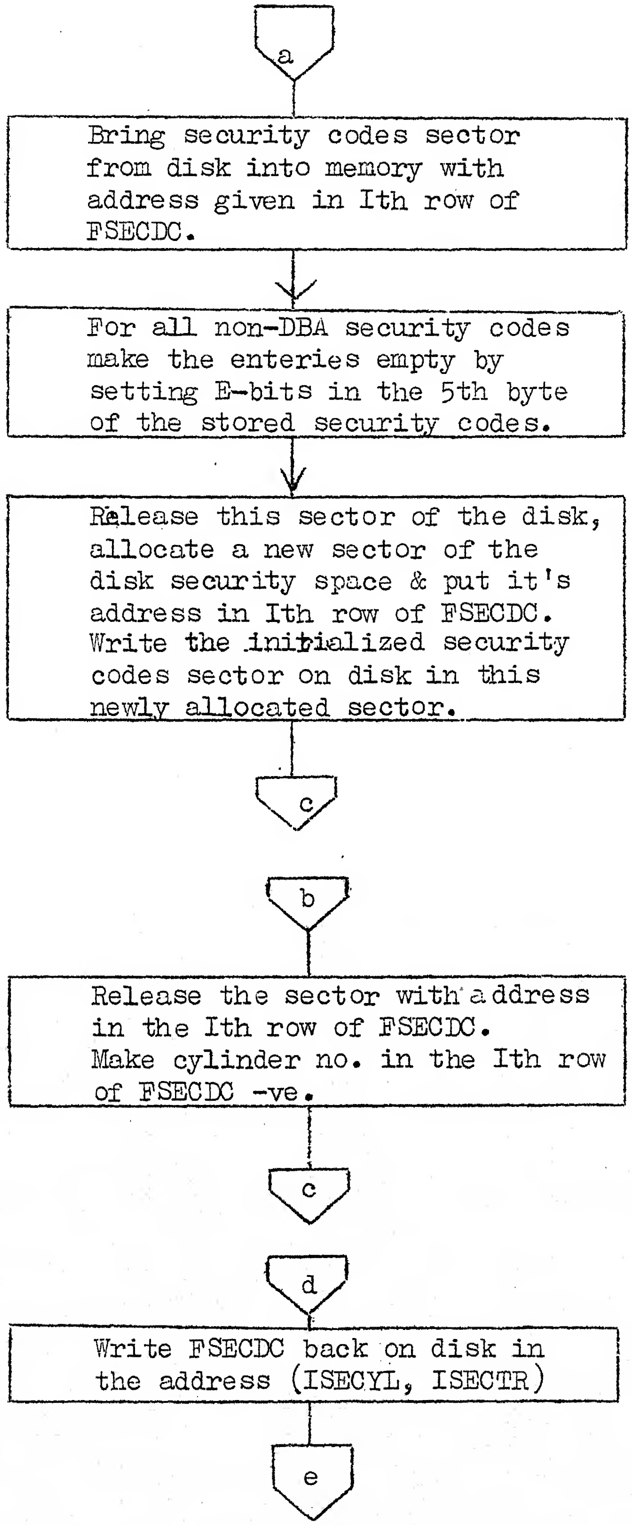


Figure 3-1: Continued on next page.

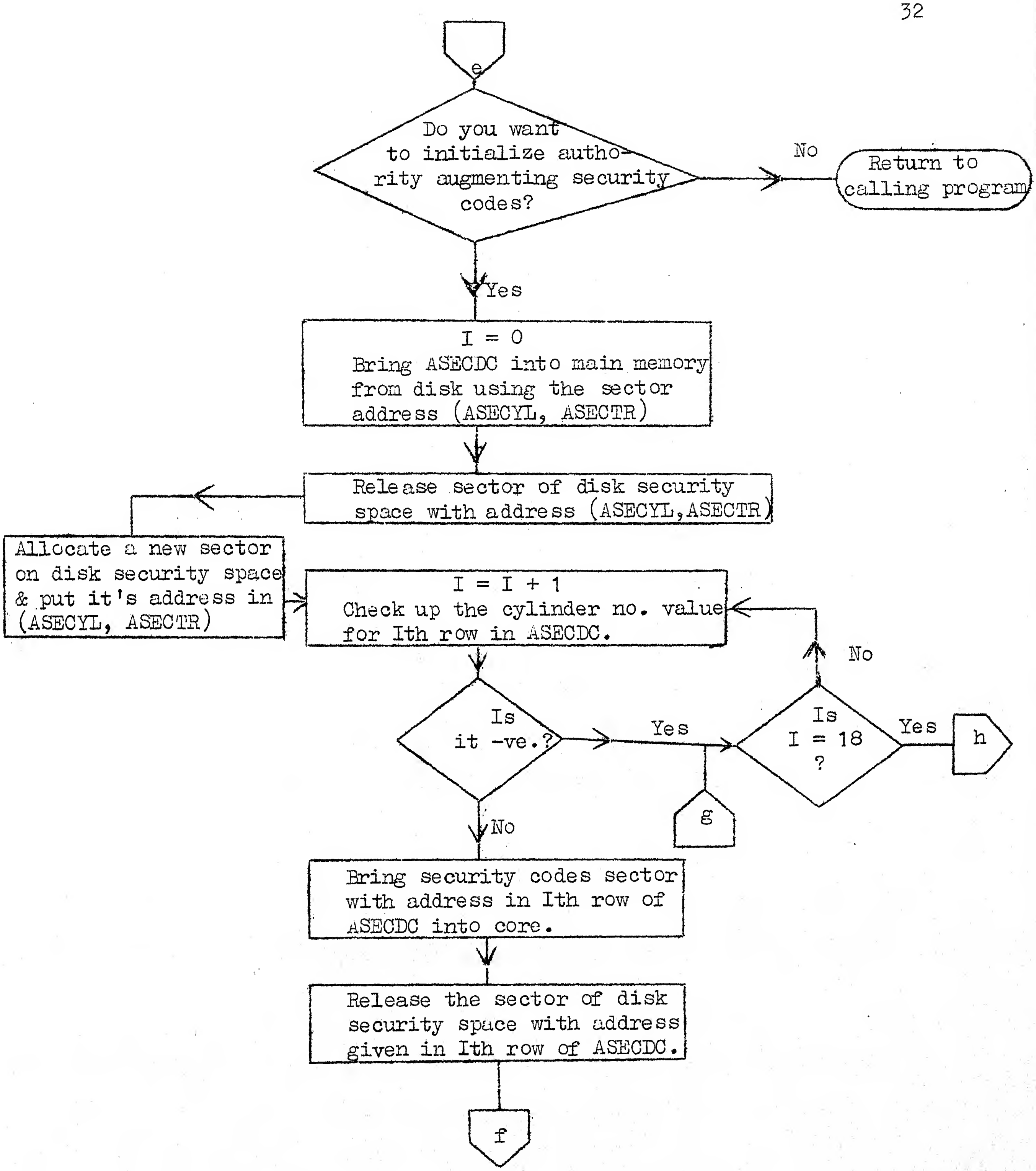


Figure 3-1: Continued on next page.

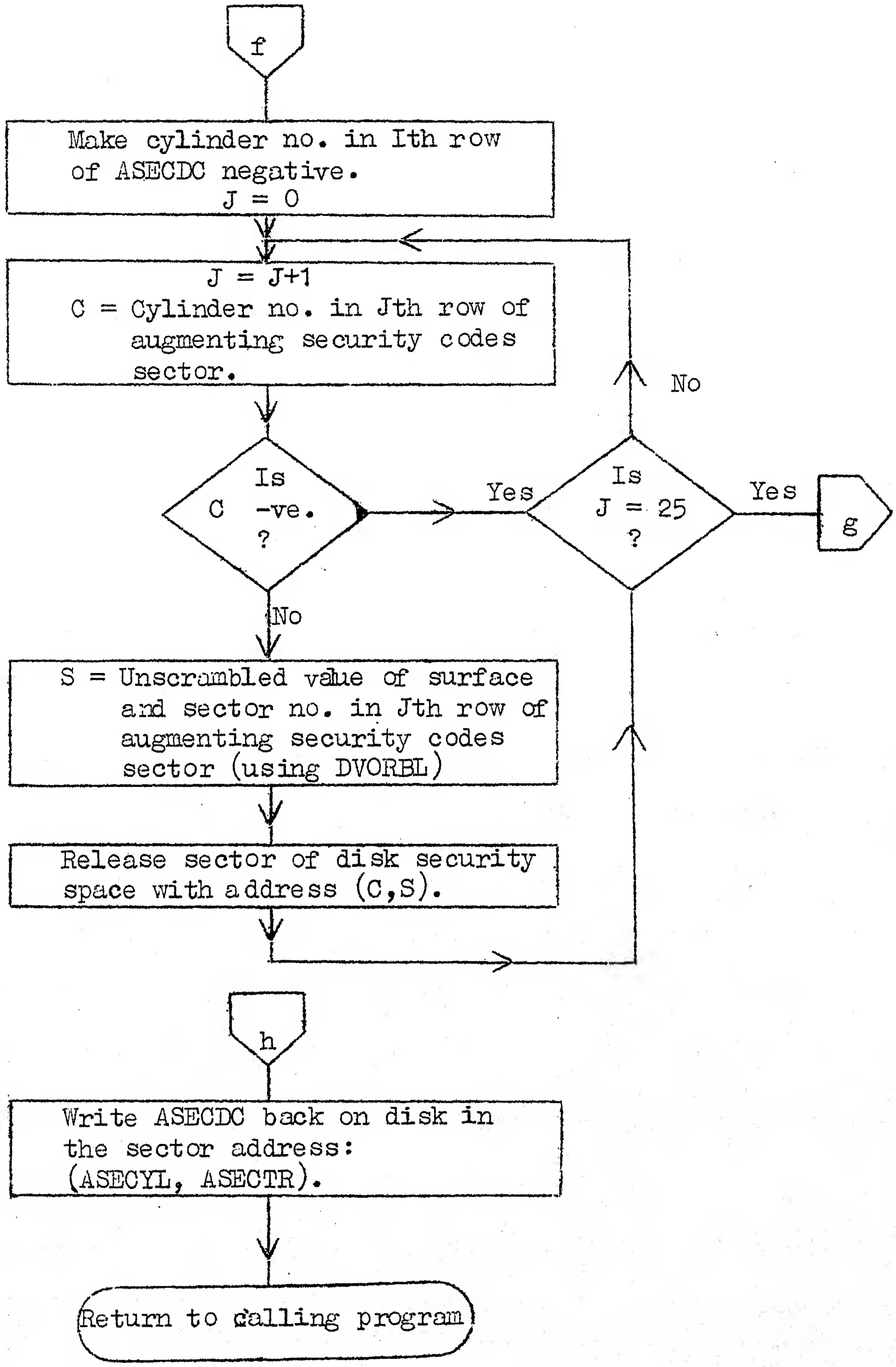


Figure 3-1: Flowchart for initializing the security codes.

4. MODIFYING THE SECURITY TABLES

Modification of the First Security Code's Tables can be done in any of the following ways:

1. Deleting a first security code
2. Inserting a new first security code or replacing an existing one.

Modification of the authority augmenting security code can be done in any of the following ways:

1. Deleting the security code (and hence also its associated authority augmenting vector).
2. Inserting a security code and its associated authority augmenting vector.
3. Changing an already existing authority augmenting security code while leaving its associated augmenting vector intact.
4. Changing the authority augmenting vector while leaving its associated security code (already existing) intact.

Deletion of any security code (of either type) can be done by specifying only its first three digits i.e., its position. The syntax of the language statements for deleting a security code is described below in terms of its fields:

First field (one ch)	= 'D' indicating deletion of security code.
2nd field (one ch)	= '1' if first security code is to be deleted = '2' if authority augmenting security code is to be deleted
3rd field (3 chars)	= '3 digit No.' indicating the position of the security code.
4th field (one char.)	= "." It is statement terminator.

For inserting a new security code or changing the value of an existing security code or authority vector, the syntax of the language statements is described below in terms of its fields -

First field (one character) = 'E' indicating insertion of new security code or authority augmenting vector or both.

Second field (one character) =

'1' if first security code is to be inserted or changed.

'2' if value of an existing authority augmenting security code is to be change leaving its associated authority augmenting vector intact.

'3' if a new authority augmenting security code with its associated vector is to be inserted.

'4' if the vector associated with an existing authority augmenting security code is to be charged while leaving the security code intact.

Third field =

'13 digit security code' (for second field = 1,2 or 3)

'3 digit No.' indicating position of security code (for second field = 4)

Fourth field =

Authority vector with syntax explained below (for second field = 3 or 4)
Null (for second field = 1 or 2)

Fifth field (one character) = '.' It is statement terminator.

The syntax of the authority vector (fourth field above) is expressed by the regular expression (#N, (A,)*A)* where -

N represents byte No. of the vector from where to start in decimal.

A represents contents of corresponding bytes of authority vector in octal.

e.g., "#10,011,023,054 # 55, 111, 321, 12" corresponds to the following contents of authority vector bytes.

Byte No.	Contents in Octal
1 to 9	000
10	011
11	023
12	054
13 to 54	000
55	111
56	321
57	012
58 to 256	000

Now we shall see examples for all types of statements alongwith their explanations:

Example 1: "D1 123."

This statement shall delete first security code whose first three digits are 123.

Example 2: "D2 421." : This statement shall delete authority augmenting security code whose first three digits are 421.

Example 3: "E1 1591111111111.": This statement inserts the first security code "1591111111111" in the set of valid first security codes. If a first security code starting with "159" digits already exists, the new security code takes its place and previous code is removed.

Example 4: "E2 1261111111111.": This statement changes an already existing authority augmenting security code while leaving the associated vector intact. If no authority augmenting code with positional digits "126" exists, this statement is ignored and an error message is printed.

Example 5: "E3 0211111111111 ≠ 10,011,230 ≠ 20, 11.": This statement introduces an authority augmenting security code "0211111111111" in the list of valid codes with the associated authority augmenting vector as below:

Byte No.	Contents in Octal
1 to 9	000
10	011
11	230
12 to 19	000
20	011
21 to 256	000

If an augmenting security code with positional digits "021" already exists, then the value of this security code and its associated vector are replaced by new values of both.

Example 6: "E4 111 #10,011,230#20,11." : This statement changes the authority vector associated with the authority augmenting security code whose positional digits are "111" from present value to that shown in Example 5 above, while leaving the security code value intact. If no security code with positional digits "111" exists already, this statement is ignored and an error message is printed.

Any number of these modification statements can be given at a time through the input device which can be a card reader ("CA"), high speed paper tape reader ("PA") or keyboard ("KY"). More than one statement can be put on one card and a single statement can be continued on many cards. All columns (1-80) are usable. There can be arbitrary number of blanks between various fields of a statement and between statements. To indicate that no more statements follow, we put the character "F" after period of the last statement.

MODIFICATION ALGORITHM

Assumptions made -

1. GET routine is available. This routine when called puts the next character of the input in the variable "CH ". When calling this routine for the first time in the program, we clear the variable FLAG of this routine to indicate fresh input. Also the variable INPUT is loaded with the device number of the input device before calling this routine.
2. GET.3(N) routine is available which reads the 3 characters (digits) of input and puts their binary value in N.
3. GET.10(N1) reoutine is available which reads ten characters from input and puts them in a buffer starting from location N1.
4. WORBLE (N1,N2) routine is available which generates a ten digit number from two 10 digit number inputs from buffers N1 and N2 and puts the generated result in buffer N1.
5. GIVSEC (N1,N2) routine is available which takes 10 byte (digit) input from the buffer N1 and puts its 4 bytes binary equivalent in buffer N2.
6. AUTHSC routine is available which reads the authority vector part of the input modification statement and builds its equivalent authority vector in a specified area of the core.

The program for all the six routines above appear in the Program Listings.

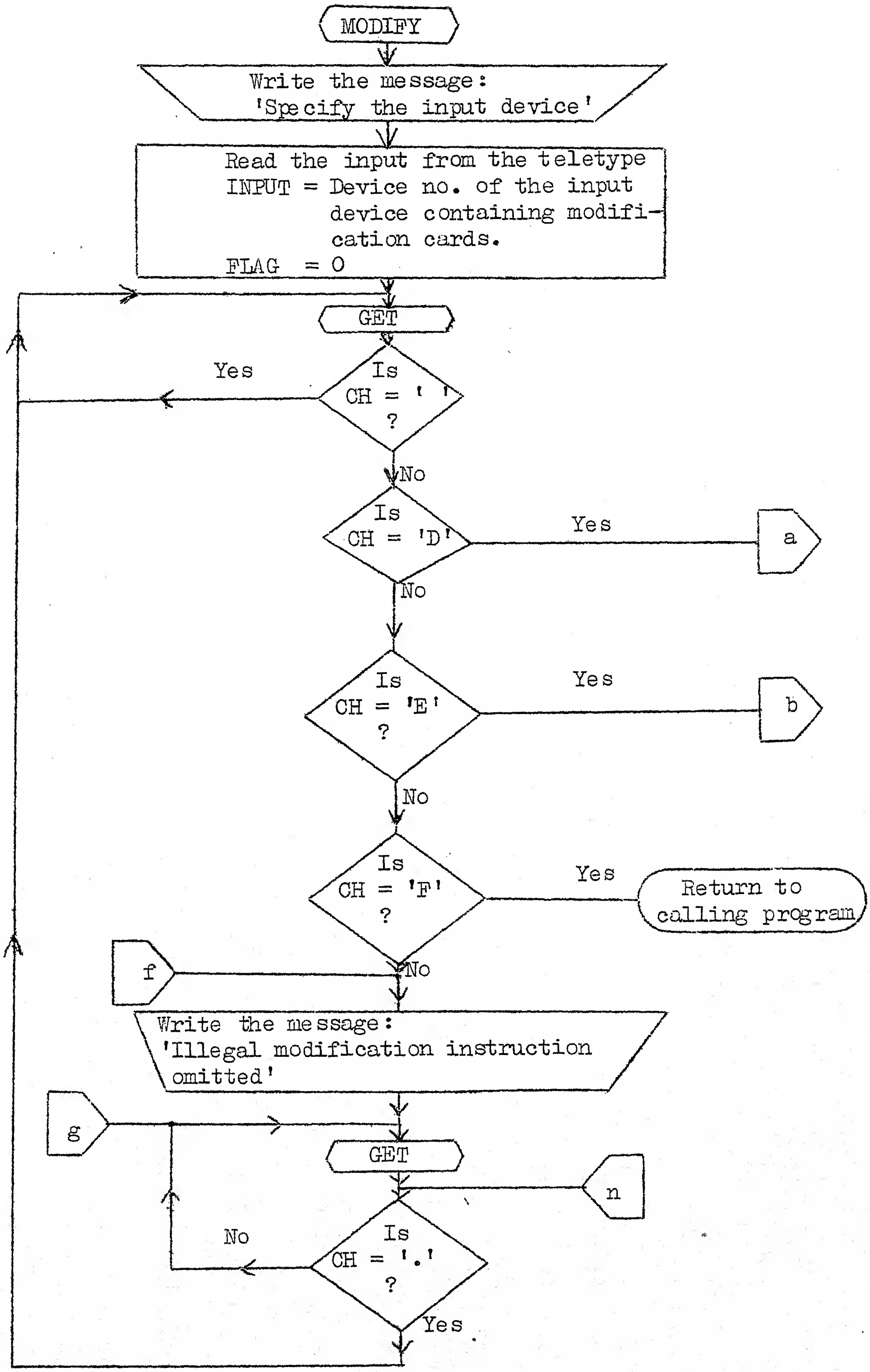


Figure 4-1: Continued on next page.

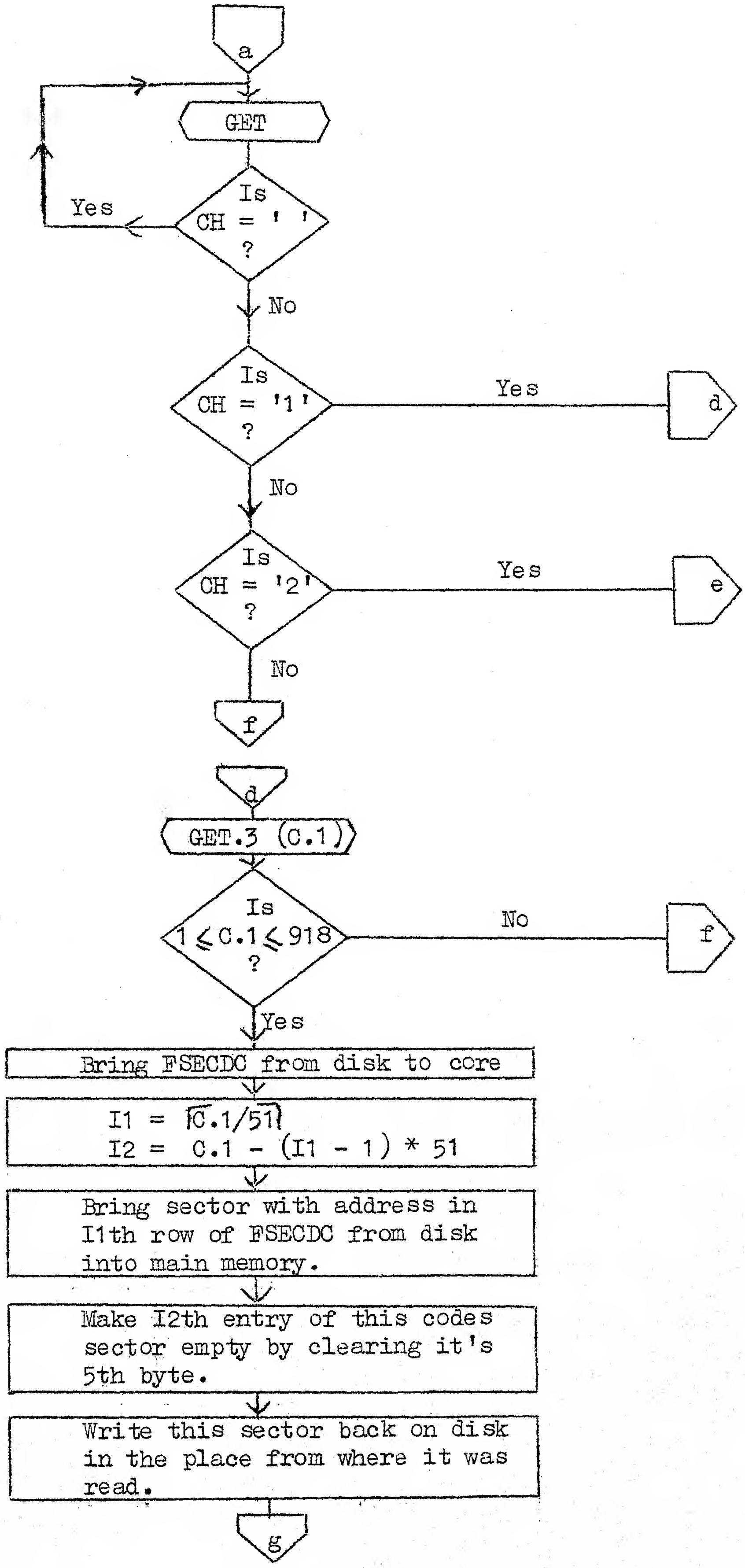


Figure 4.1: Continued on next page.

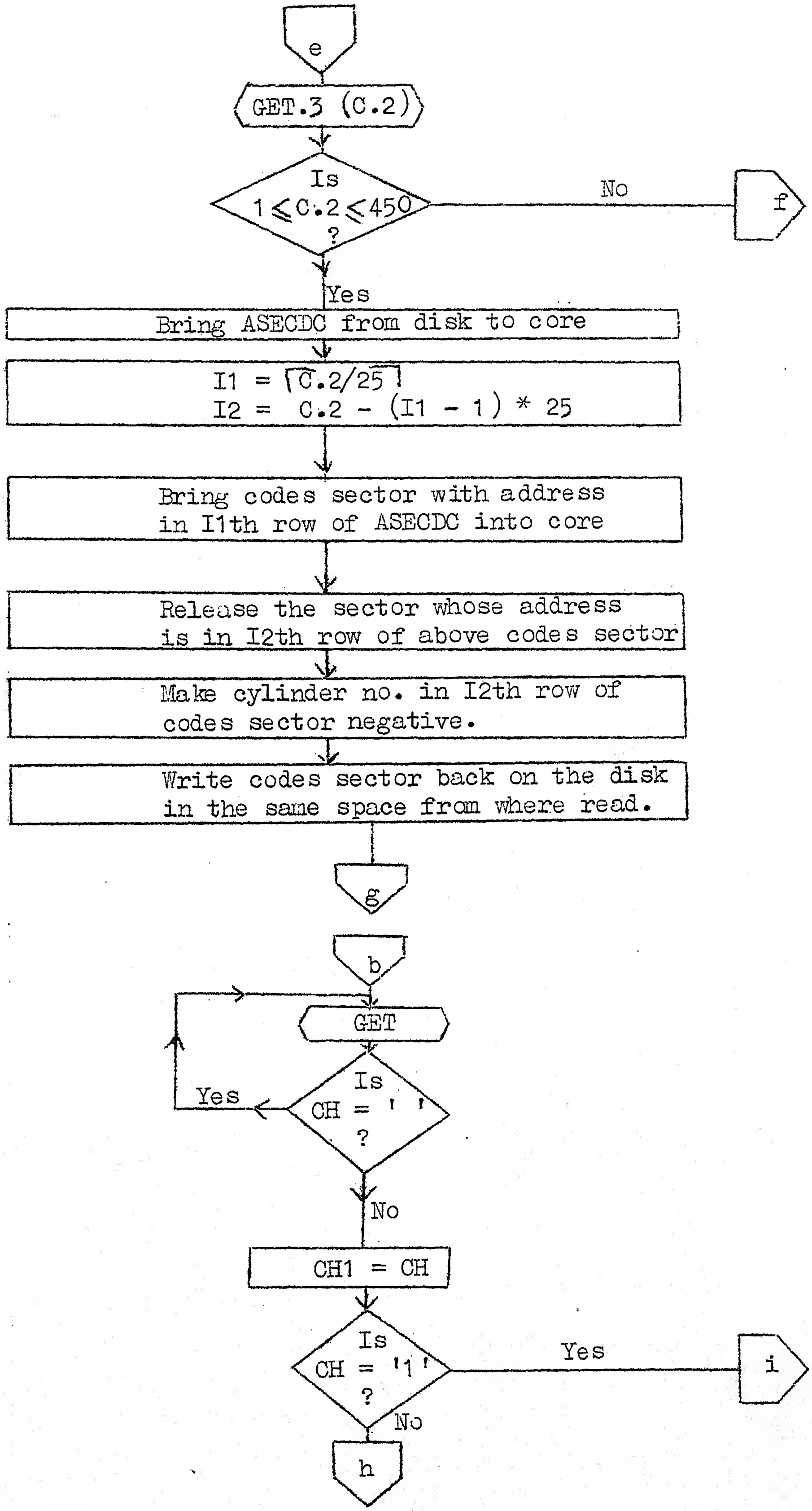


Figure 4-1: Continued on next page.

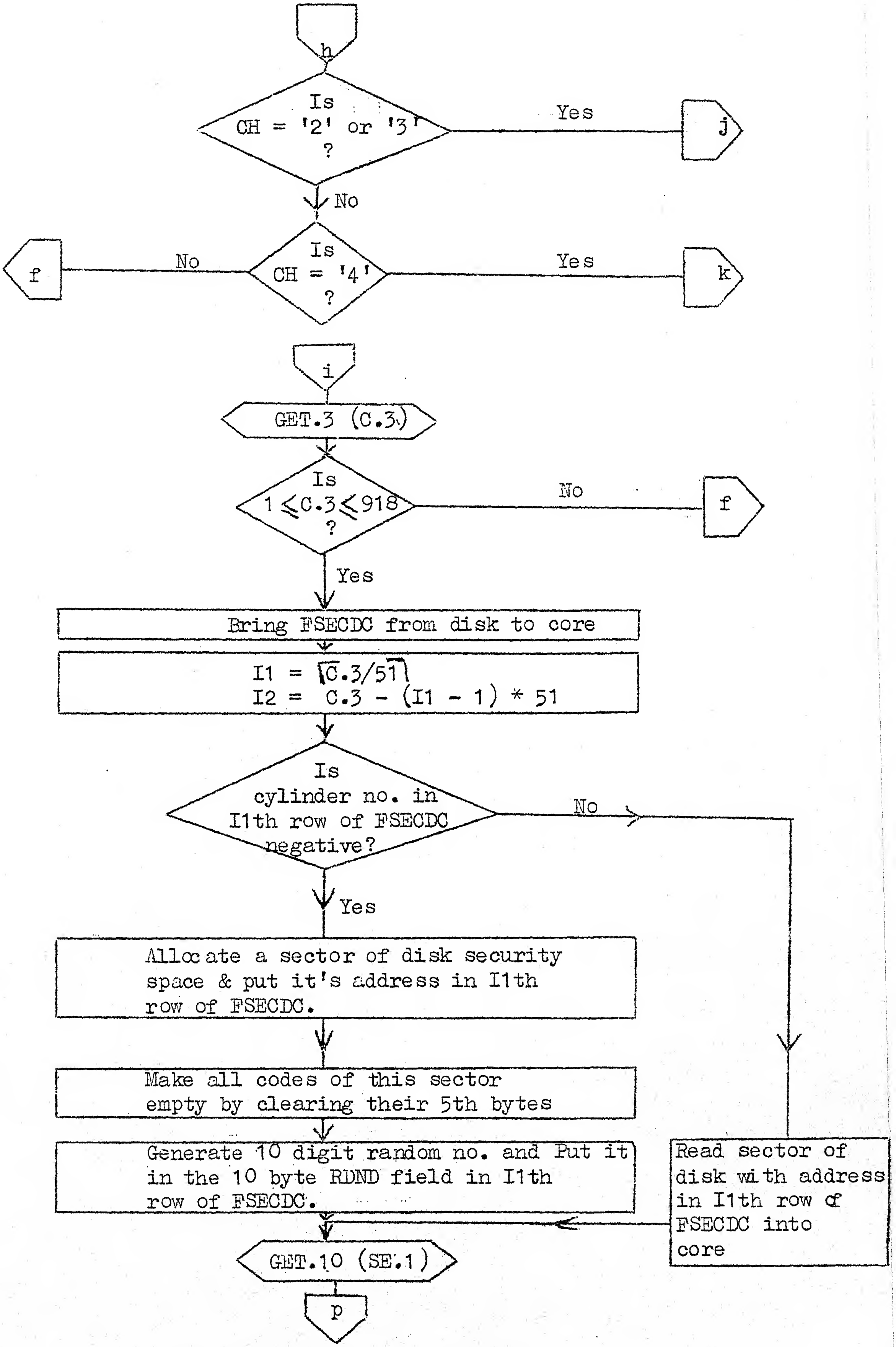


Figure 4-1: Continued on next page.

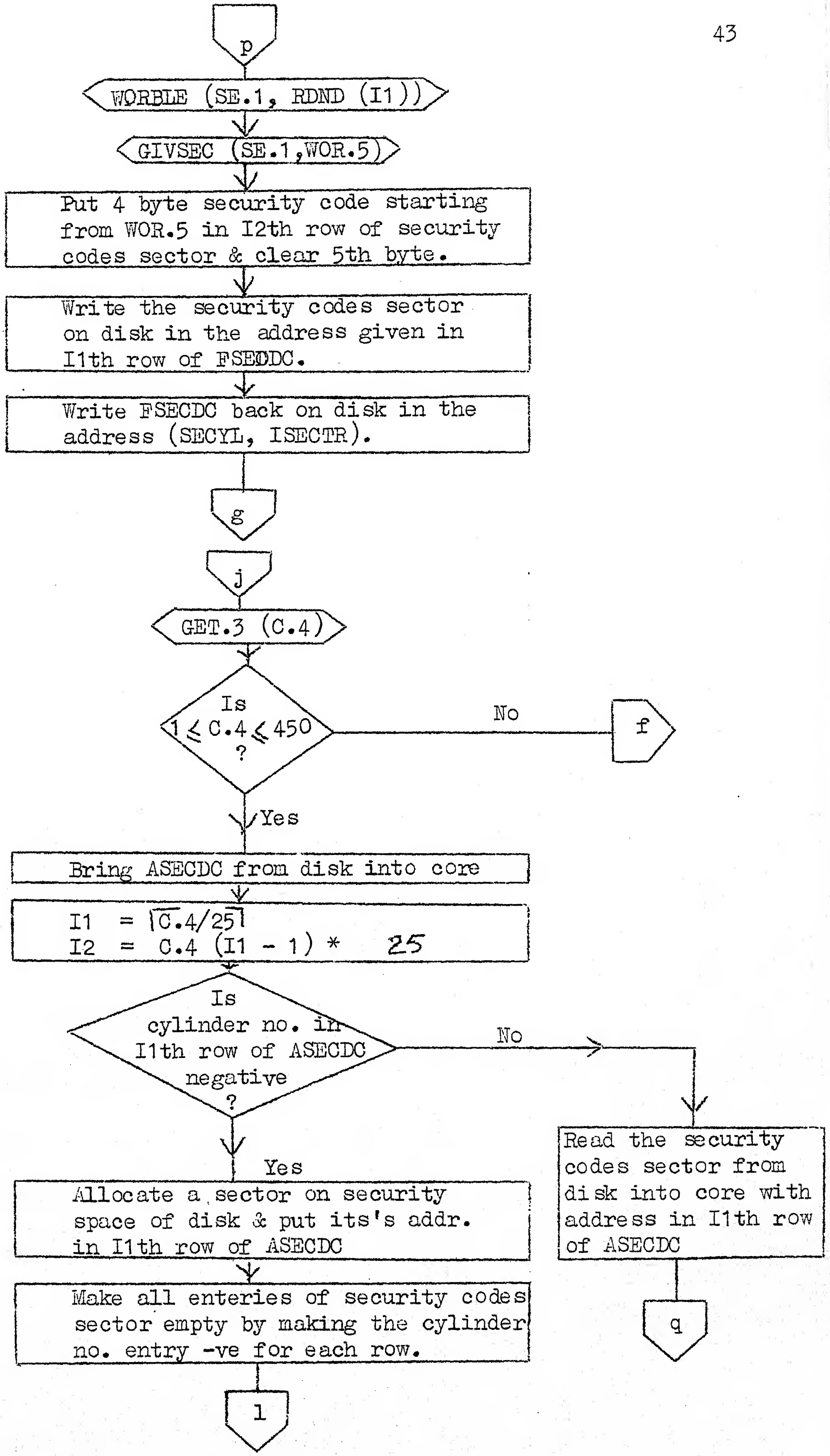


Figure 4-1: Continued on next page.

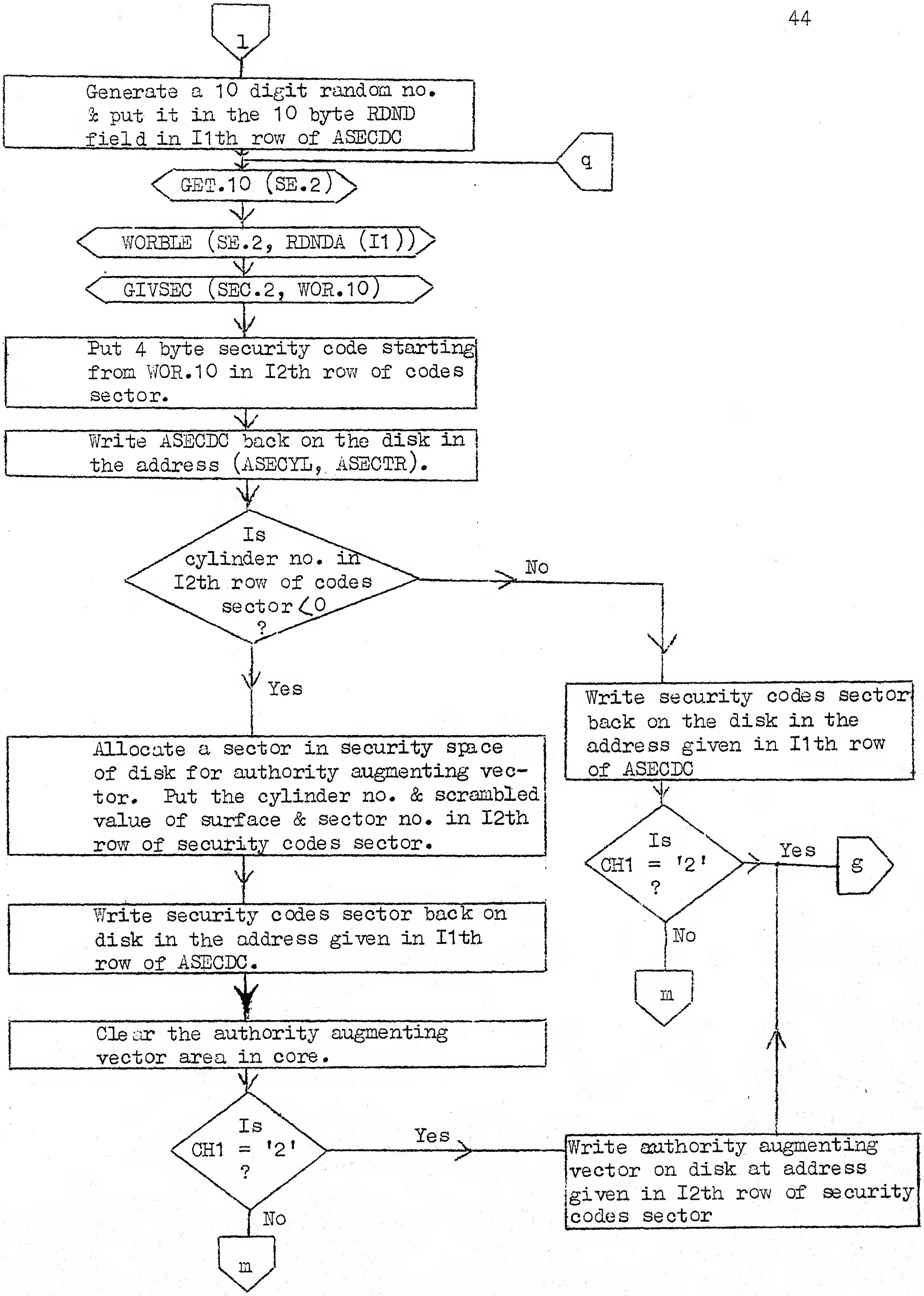


Figure 4-1: Continued on next page.

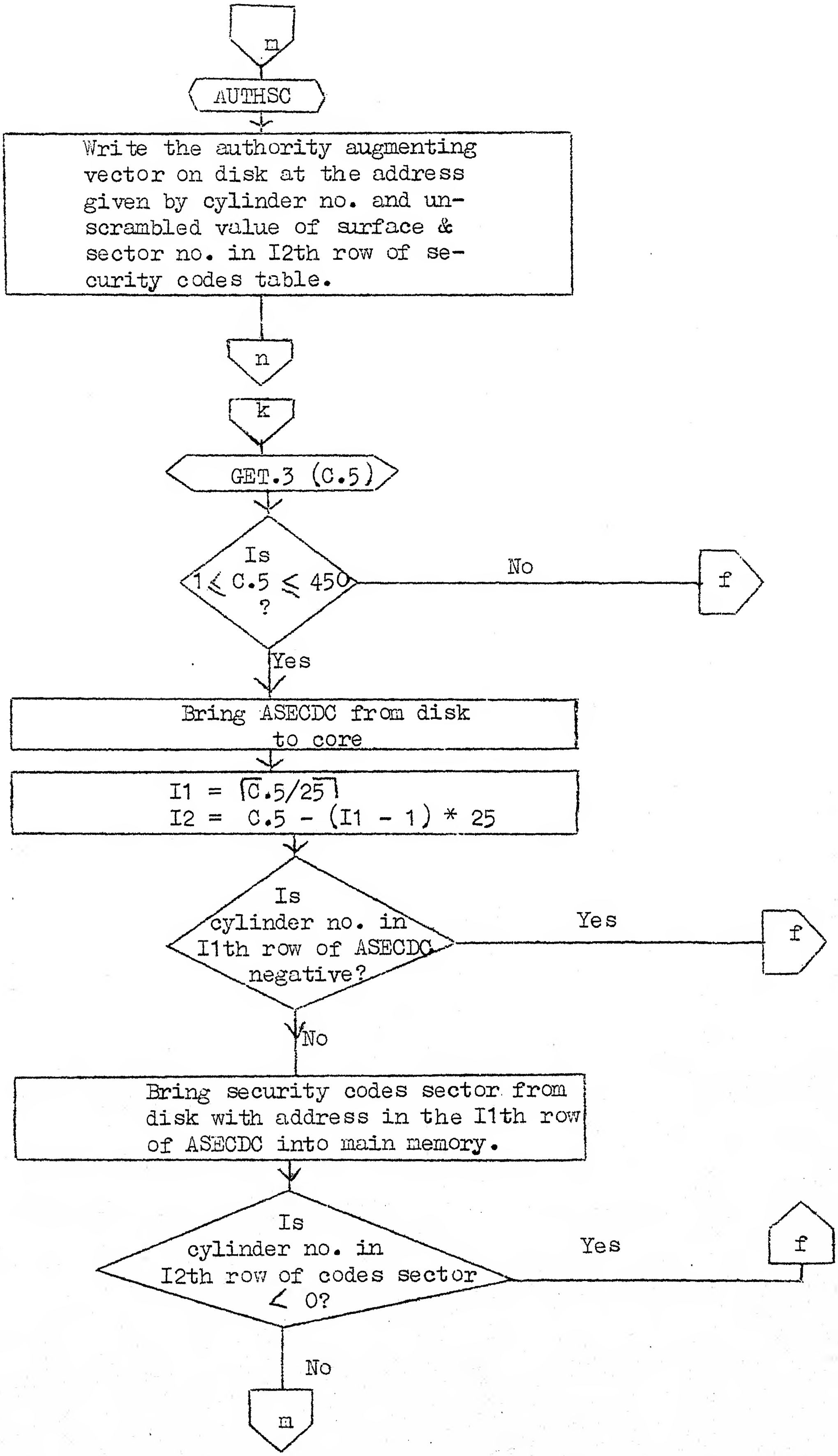


Figure 4-1: Flowchart for modifying the security codes' tables.

The modification algorithm in the form of a flowchart is shown in Figure 4-1. The program for this algorithm appears in the Program Listings appearing at the end of the thesis.

After modifying the security tables, the DBA can print the tables to satisfy himself that proper modification has been carried out. This he can do using the PRINTS routine which is given in the next chapter.

5. PRINTING THE SECURITY TABLES

ALGORITHM FOR PRINTING

The data base administrator may be interested in knowing the status of security tables at any time. The "PRINTS" routine gives the DBA the facility of printing FIRST Security codes' tabless and Authority Augmenting Security Codes Tables. First the DBA is asked to specify the output device where the tables are to be printed. The DBA gives "PR" for line printer and "TT" for teletype. Thereafter, system asks the DBA if he wants to print "First Security Codes' Tables". DBA gives "Y" "Lf", if he wants to print the tables. Otherwise he gives "N" "Lf". Similarly the DBA is asked if he wants to print "Authority Augmenting Security Codes' Tables". Again he gives "Y" "Lf". for printing the tables and "N" "Lf." for not printing the same.

In case of First Security Codes, first the system prints "First Security CodesTable Directory", i.e., FSECDC in the format of Figure 2-4. Then the system prints each existing first security code along with its status. Status can be any of the following -

(i) A blank status field indicates that the code has been used properly.

(ii) "ILLGLE" in status field indicates that the user tried to give wrong authority augmenting code to access the system illegally.

(iii) "MORASK" in status field indicates that the user tried to ask the system for more than permitted to him, by giving such retrieval or update commands as were not permitted to him.

In case of Authority Augmenting Security Codes, the system first prints "Augmenting Security Codes Table Directory" i.e., ASECDC in the format of Figure 2-8. Thereafter, the system prints each existing authority augmenting code alongwith its associated authority augmenting vector. It also prints the sector address where this authority vector is stored on the disk. Since at any time, the data base shall generally contain much lesser number of fields then the maximum 256 permitted, the PRINTS routine asks the DBA to give a three digit input number (say N) specifying numberof fields in the system. Then it prints only the first N fields of each authority vector. Moreover, if the DBA does not want to print any authority vectors but only the authority augmenting security codes, he may give N=0.

The flowchart of the algorithm for printing security codes appears in Figure 5-1. The equivalent program of this algorithm appears in the program listings.

TERMINATING THE JOB

Before terminating DBA's job, we must write all the variable data as outlined in Flowchart 5-2 back on the disk. So at the end of any operation that the DBA may perform on the data base, he must perform the job "TERMNT". With this, all useful information in core gets stored back on the disk and may be fetched for later usage.

Having described all the programs that go into building the security system for the data base, the only function left is removing a relation from the data base which is the subject matter for the next chapter.

-

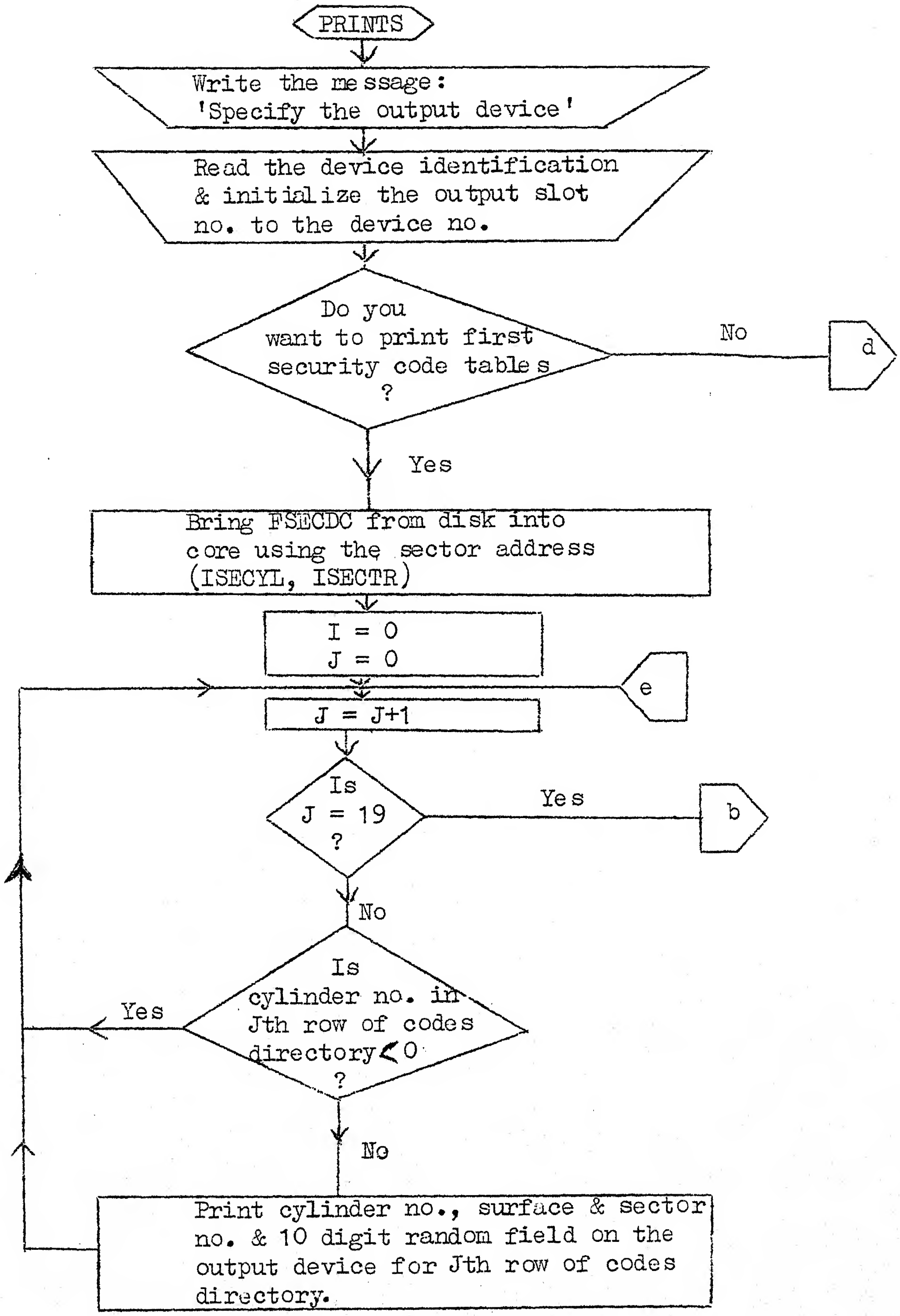


Figure 5-1: Continued on next page.

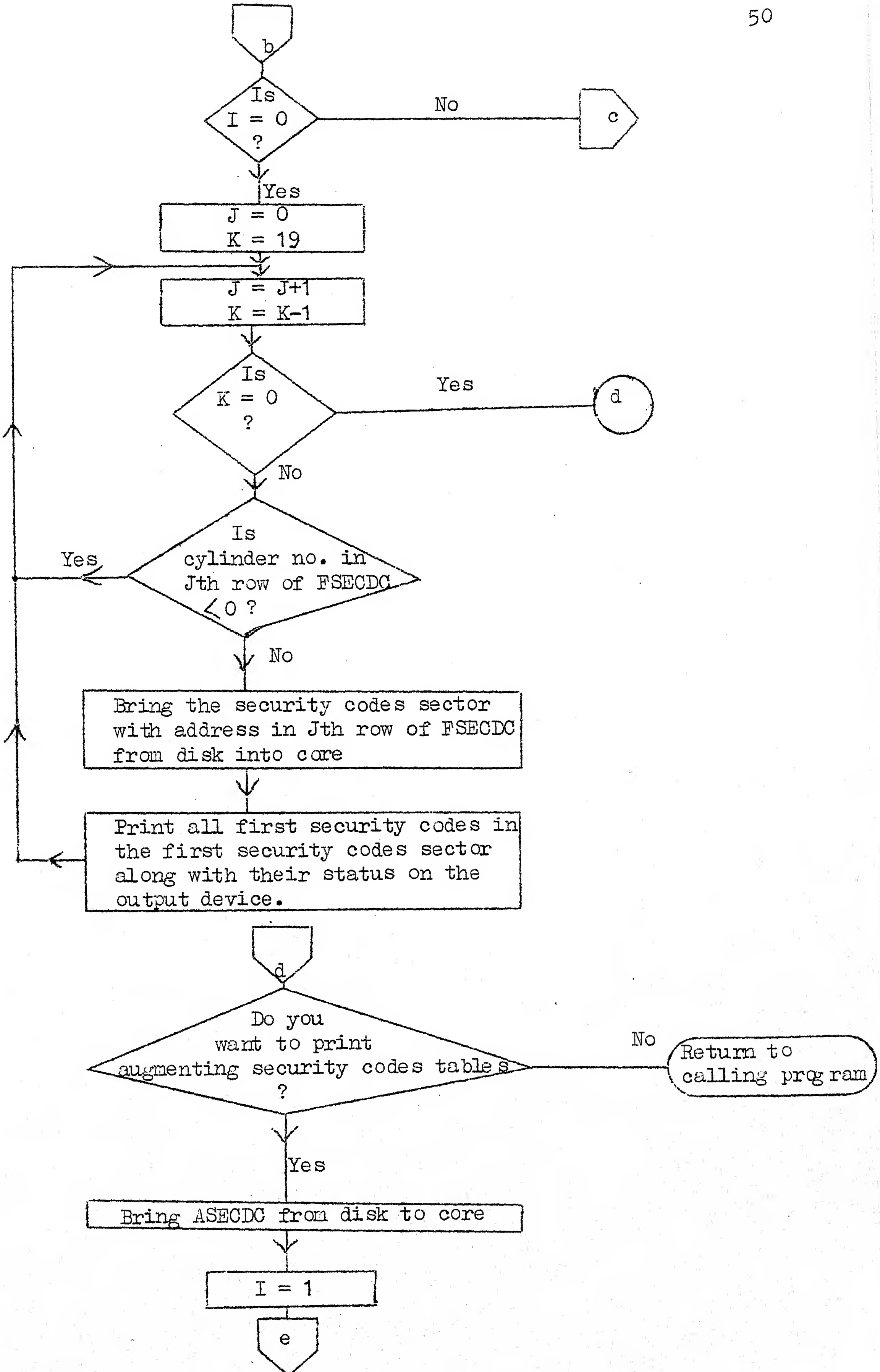


Figure 5-1: Continued on next page.

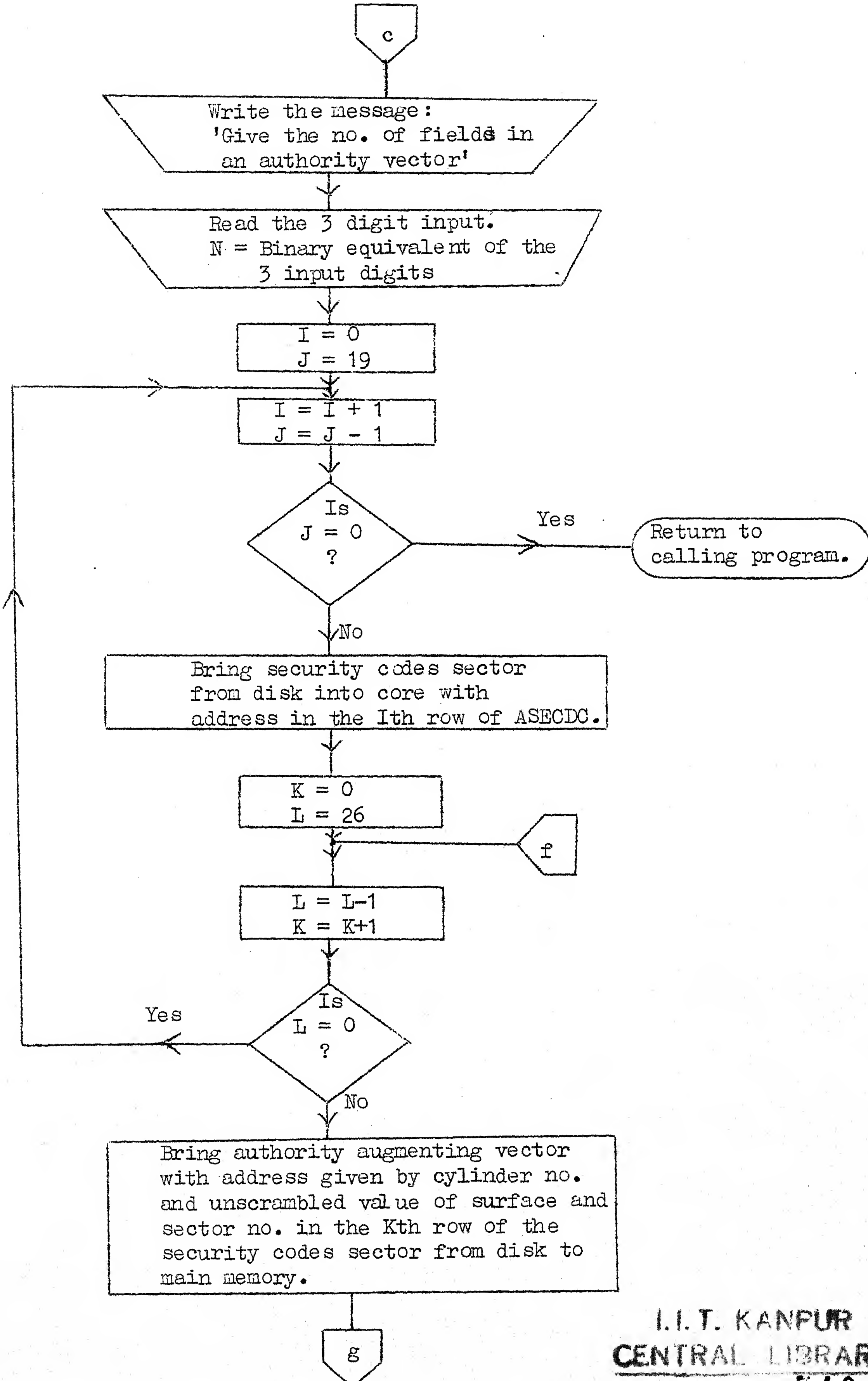


Figure 5-1: Continued on next page.

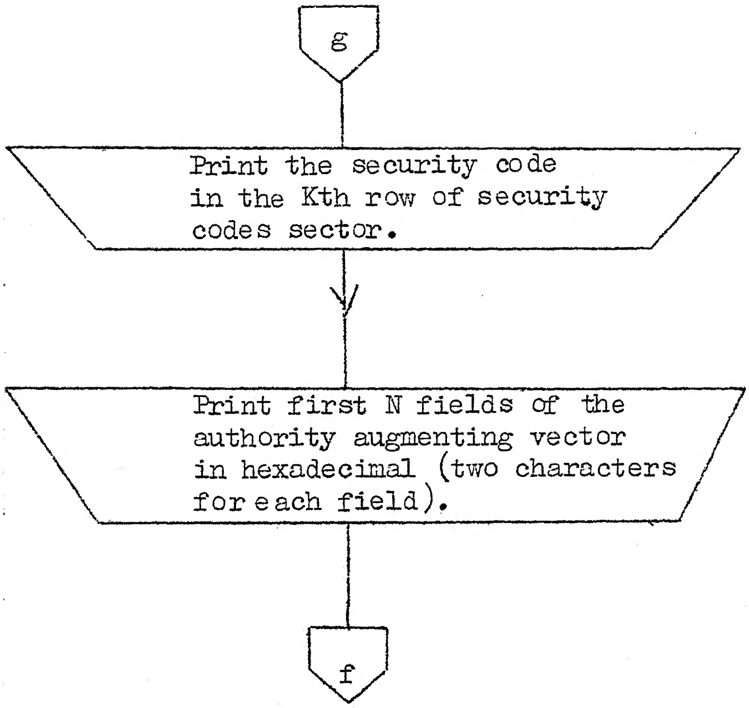


Figure 5-1: Flowchart for printing the security codes tables.

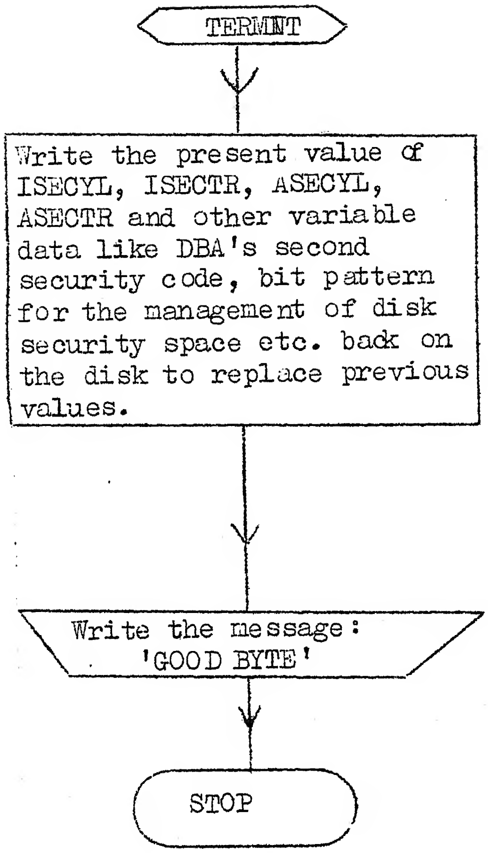


Figure 5-2: Flowchart for terminating DBA's job.

6. REMOVING A RELATION

As a data base grows older with time, it may become necessary to add more relation to the data base which may pertain to some data which has currently acquired importance, or to remove some relations which pertain to the data which has lost its relevance, or to re-organise the data base by combining some relations into one or breaking one relation into many or any combination of these in order to improve the efficiency of the system in the light of the past queries.

To illustrate by example let us say that we have a data base in IIT Kanpur where we store one relation for each year of students. Now as a new batch enters, a new relation shall have to be added to the system. But the relation corresponding to the outgoing batch may be dumped on some tape file (for any possible emergency need) and then removed from the data base.

Adding a relation is done by BUILDR whose programs appear in a separate thesis (Ref. 5). The present chapter discusses removing a relation. Since all the data structures used here appear in the thesis describing BUILDR programs, it is essential to go through it before studying this algorithm.

REMOVAL ALGORITHM

Removing of a relation from the data base involves the following tasks -

1. Removing this relation from the Relations Directory RELDIR by clearing the RELID field for this relation, so that this relation identifiation number can be used to define new relation.

2. Removing the field records corresponding to this relation from the field list "FDLIST" and closing this gap by moving the field records lying below this gap upwards.
3. Setting the cylinders occupied by the relation on the disk free, by clearing their status bits in the bit vector (BITMAP).
4. Clearing the entries corresponding to this relation from the primary index table and moving the other entries up to close the gap.
5. For all existing relations whose primary index entries have been moved up, reflecting this movement in the relations directory RELDIR by subtracting the length of the gap (ie., length of upward movement) from their PMINX field values.
6. Writing these new tables values of RELDIR, FDLIST, primary index etc. back on the disk.

All these steps are reflected in the flowchart of removal algorithm shown in Figure 6-1. The flowchart uses a routine RELCYL(N) which releases cylinder No. N of the disk and returns control to the calling program. Flowchart of this routine has been drawn in Figure 6-2. Programs corresponding to these two flowcharts appear in the Program Listings.

A FEW WORDS ON REORGANIZATION

Reorganization can be of two kinds:

1. Reorganizing the data base by merging two or more relation or breaking one relation into many or a combination of both to build new relations. This can be done as follows:

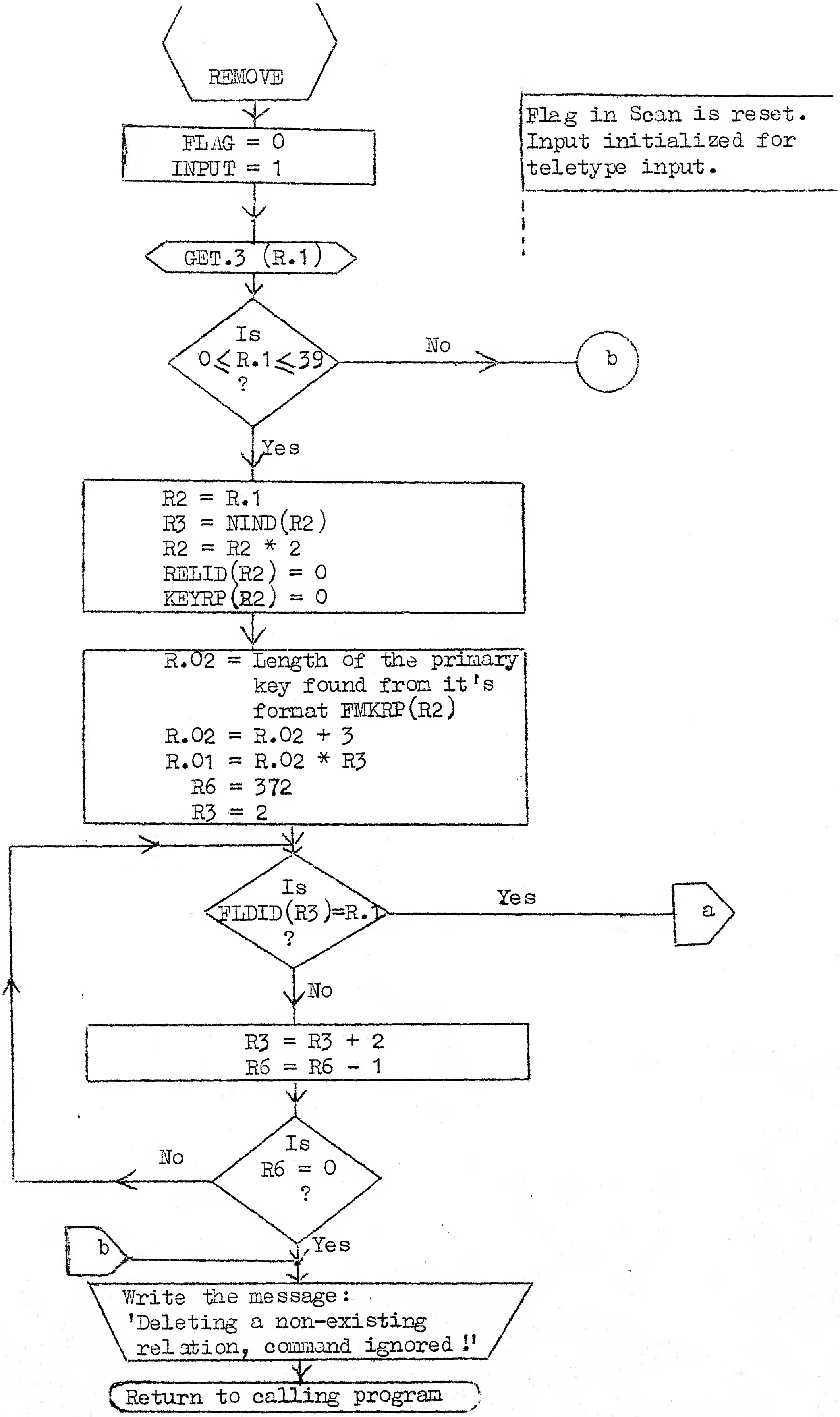


Figure 6-1: Continued on next page.

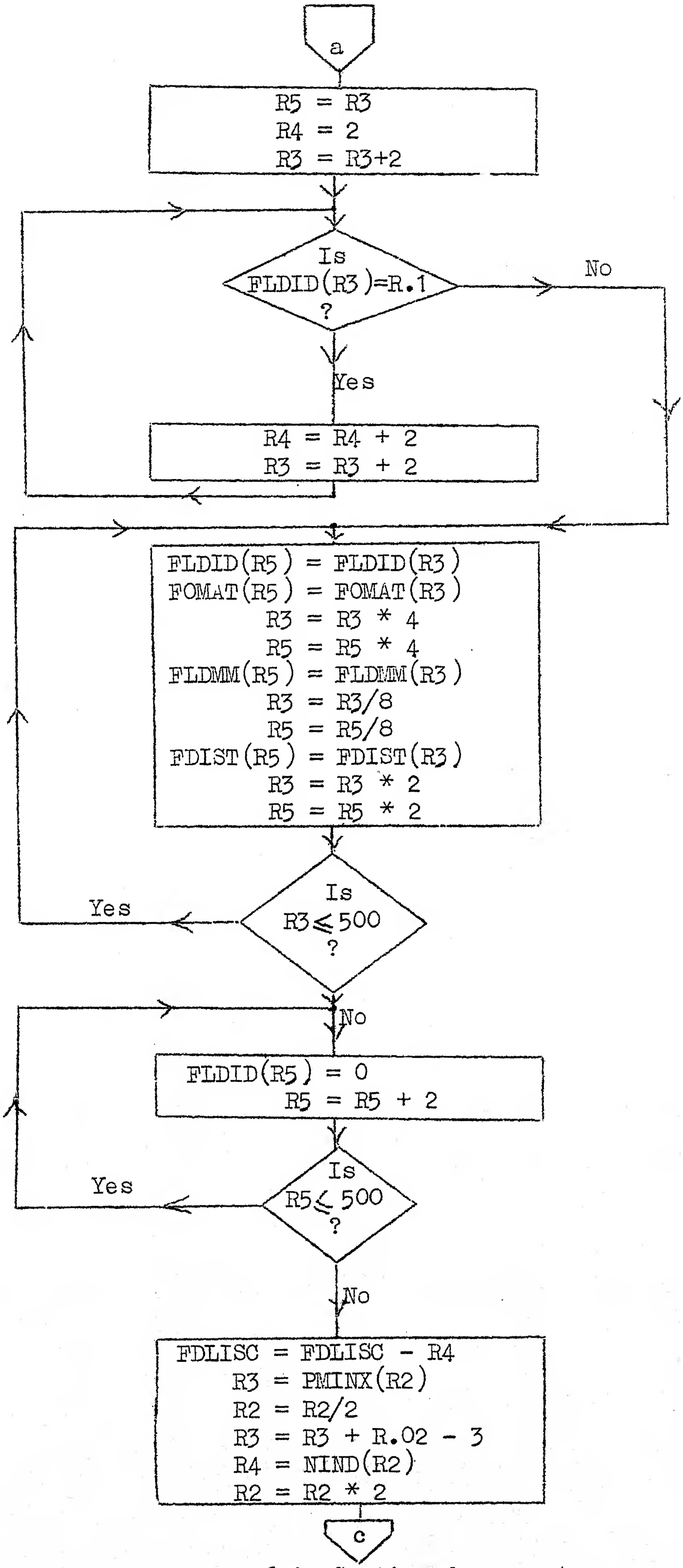


Figure 6-1: Continued on next page.

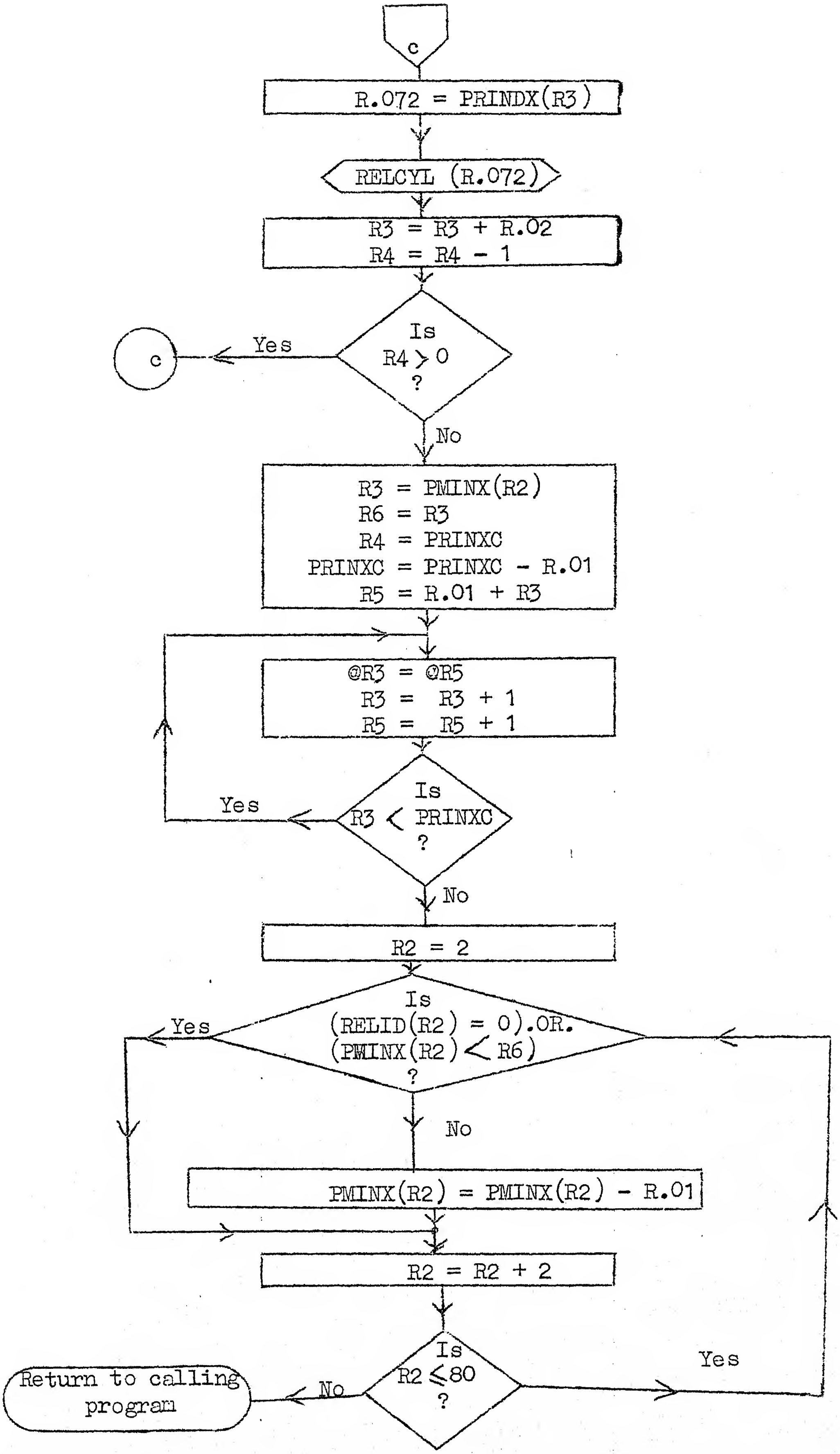


Figure 6-1: Flowchart for removing a relation from the data base.

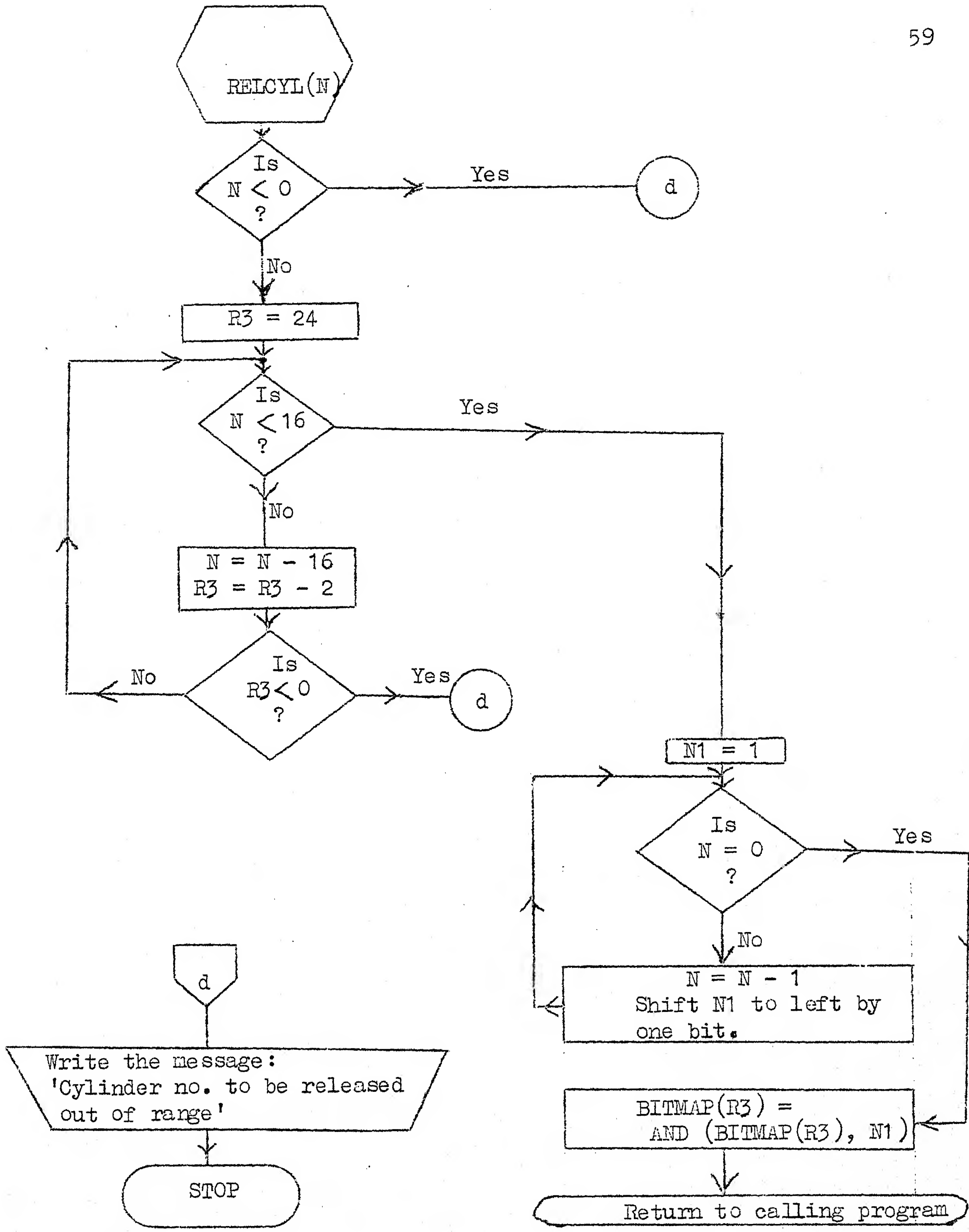


Figure 6-2: Subroutine for releasing a cylinder of the disk.

(i) Retrieve the new relations to be created one by one by giving appropriate retrieval commands with output going on the disk (in a prefixed area).

(ii) Build these new relations by using BUILDR routine of (Ref. 5) by giving the specification of the new relations and reading the data from the disk.

(iii) Remove the older relations which have become redundant as a result of the creation of these new relations.

2. Reorganizing the data base by reorganising the relations such that all data from their overflow area is brought back into regular area and overflow area is cleared. This can be done for each relation to be reorganised as follows:

(i) Retreieve the relation with output going to diskbby giving appropriate retrieval command.

(ii) Remove this routine from the data base using REMOVE routine.

(iii) Build this relation using BUILDR routine by giving the specification of this relation and reading the data from the disk.

Hence using above steps the DBA can reorganise the data base in any manner he likes.

REFERENCES

1. Agarwala, S., "Updating of a Relational Data Base System on TDC-316", M.Tech. Thesis, Computer Science Programme, Indian Institute of Technology, Kanpur, July 1978.
2. Chamberlin, D.D., "Relational Data-Base Management Systems", ACM Computing Surveys, March 1976, Vol. 8, No. 1, pp. 43-66.
3. Codd, E.F., "A Relational Model of Data for Large Shared Data Banks", Comm. of ACM, Vol. 13, No. 6, June 1970, pp. 370-397.
4. Date, C.J., "An Introduction to Data Base Systems", Addison-Wesley Publishing Company, 1975.
5. Ghanekar, D.K., "An Implementation of a Relational Data Base Model", M.Tech. Thesis, Computer Science Program, Indian Institute of Technology, Kanpur, July 1977.
6. Martin, J., "Principles of Data Base-Management", Prentice-Hall of India Pvt. Ltd., 1977.
7. Sat Pal, "An Information Retrieval System for a Relational Data Base", M.Tech. Thesis, Computer Science Programme, Indian Institute of Technology, Kanpur, July 1978.
8. Sibley, E.H., Fry, James, P., "Evaluation of Data-Base Management Systems", ACM Computing Survey, March 1976, Vol. 8, No. 1, pp. 7-72.
9. Wiederhold, G., "Data Base Design", McGraw-Hill Book Company, 1977.

Appendix 1

INITIAL LOADING OF THE SYSTEM

We have seen that in our system all the programs and security tables reside on the disk. Therefore to load the system initially i.e., to generate the system, the following steps must be followed.

1. Load the "initial loading program" from paper tape into core. Execute it with starting address = 130000. This will put the routines WORBLE, DVORBL, VORBLE, GIVSEC on the preassigned sectors of the disk and will also initialise the security codes' tables so as to contain only one security code (that of DBA), with its value being 0291234512345 and also DBA's identification number being 000000000000 for values shown in the listings.
2. Load the paper tape for "program to load other programs" as shown in the listings into core.
3. Load paper tapes of all security programs into core except the START program (which is incorporated under KDM) with address ranges as below:

1. PRINTS & TERMNT	70000 to 76000
2. DBA, ALLOCTS, RELSEC	76000 to 100240
3. Utility Routines	100400 to 102200
4. INTLZE	102400 to 104000
5. MODIFY	104100 to 107500

4. Load the paper tapes of REMOVE and PUT routines into core with address range as below:

1. PUT	66000 to 66200
2. REMOVE	66400 to 67700

5. Load the programs developed for BUILDING of a relation developed as part of (Ref. 5) into core with address range as below:

1. SCANNER	27600 to 46400
2. STATIC Routine 1	46400 to 50430
3. BUILD	50440 to 54340
4. INDATA	54400 to 56230
5. STATIC Routine 2	56300 to 57700
6. MAIN	60000 to 65720

6. Execute the "program to load other programs" starting at address 20000. Execution of this program puts all the security programs and programs to build and remove a relation etc., from core into areas of the disk about which information is contained in "Initial loading program."
7. Load the retrieval programs developed as part of (Ref. 7) into core.
8. Load the paper tape of "program to load other programs" into core with X containing the value of symbol NR and Y containing the value of symbol NR1 of Initial Loading Program.
9. Execute the "program to load other programs" again starting from 20000. This will load all retrieval programs also into preassigned areas of disk.
10. Repeat Steps 7, 8 and 9 for update programs developed as part of (Ref. 1) with X containing value of symbol NU and Y containing value of symbol NU1 of Initial Loading Programs. This will put update programs also into prefixed areas of the disk.

Now the START program incorporated under KDM with code "DB" shall call appropriate programs from the disk depending upon what the user wants to do, as detailed in Appendix 2.

Appendix 2

UNSERS' MANUAL

To use the system, the following steps must be followed:

Step 1: Press "DB". System prints a message asking the user to specify the first security code.

Step 2: User gives his 13-digit First Security Code as input from the teletype and then line feed. If user is DBA (i.e., the first security code given as input is that of the DBA) then go to Step 5 else go to next step.

Step 3: System asks the user to give his next security code (authority augmenting). User either gives 13-digit security code and then gives "Lf" or gives "N" "Lf". In the former case, the authority vector is enhanced corresponding to the authority augmenting vector associated with that security code and control goes back to Step 3. If input is "N" "Lf", go to next step.

Step 4: System asks the user to specify the job -

(i) If user gives "R" "Lf" as input from the teletype, system loads Retrieval Programs plus all other utility routines from disk into core and transfers control to retrieval programs. Then user gives retrieval query as detailed in Users' Manual for Retrieval (Ref. 7). After completion of retrieval task control goes back to Step 4.

(ii) If user gives "U" "Lf" as input from the teletype system loads update programs plus all other utility routines from disk into core and transfers control to update programs. Then user gives update query as detailed in Users' Manual for Updating (Ref. 1). After completion of update task control goes back to Step 4.

(iii) If user gives "F" "Lf" then job is finished and system gives "good-bye".

(iv) If input is none of the above, error message is given and control goes back to Step 4.

Step 5: The DBA is asked to supply the identification number which is a 12-digit number. DBA gives 12-digit number followed by "Lf" or followed by "Y" "Lf". If identication number is correct, then in latter case, DBA is asked to supply new identification number which replaces the old identification number and control goes to next step. In former case control goes directly to next Step.

Step 6: DBA is asked to specify the job. Then DBA specifies one of the jobs as shown on Page 26 of Figure 2-11. If job is "TERMNT", control goes to Step 8 else control goes to Step 7.

Step 7: If job specified is "CCCCCC", then data base is cleared and control goes back to Step 6. If job specified is "INTLZE", "MODIFY" or "REMOVE", DBA follows the procedure mentioned in Chapters 3, 4 and 6 respectively. If job specified is "RELBLD", DBA follows the instructions given in the Users' Manual of (Ref. 5). After completion of these taks control goes back to Step 6. If job is "PRINTS" DBA follows steps given in Chapter 5, and control goes to next step.

Step 8: All tables from core are stored back on the disk. Job is finished and system gives "GOOD-BYE".

```
;*************************************************************************
;*************************************************************************
;     "PROGRAM TO LOAD OTHER PROGRAMS" IS USED TO LOAD SECURITY AND      *
;     OTHER PROGRAMS USED BY THE DBA INTO PRE ASSIGNED AREAS OF THE      *
;     DISK. TO LOAD RETRIEVAL PROGRAMS,REPLACE X=ND BY X=NR & Y=ND1 BY Y*
;     Y=NR1. TO LOAD UPDATE PROGRAMS,REPLACE X=ND BY X=NU &Y=ND1 BY      *
;     Y=NU1. PROCEDURE FOR LOADING CAN BE SEEN FROM APPENDIX1            *
            .=          20000
            R1=         %1
            R2=         %2
            R3=         %3
            R4=         %4
            ND=         26146
            ND1=        26150
            NR=         26152
            NR1=        26154
            NU=         26156
            NU1=        26160
            X=          ND
            Y=          ND1
            TSR         X,R2
            TSR         Y,R3
LD1:        TSR         (R3)+,R4
            TSR         (R3)+,STR8
            TSR         (R3)+,CYL8
LD2:        TSR         (R3)+,SCT8
            JMS         R4,WRITE
CYL8:       WORD        0
SCT8:       WORD        0
STR8:       WORD        0
            ADD         #400,STR8
            DEC         R4
            BRGT        LD2
            DEC         R2
            BRGT        LD1
            STOP
WRITE:      TSB         #200,@#177456
            BRZS        WRITE
            TSR         (R4)+,@#177452
            TSR         (R4)+,@#177444
            TSR         (R4)+,@#177460
            TSR         #-128.,@#177462
            TSR         #4113,@#177454
            WAIT
SENSE:      TSB         #1,@#177456
            BRZC        SENSE
            TSB         #40000,@#177456
            BRZS        ERR.11
            RTS         R4
ERR.11:     STOP
            END
```

```
;**************************************************************************
;**************************************************************************
;     INITIAL LOADING PROGRAM PUTS THE ROUTINES VORBLE,DVORBL,GIVSEC     *
;     AND BOOBLE ON PREASSIGNED AREAS OF THE DISK. IT ALSO INITIALISES*
;     VALUES OF VARIOUS VARIABLES AND TABLES AND PUTS THEM ON THE DISK*
;     IT'S DATA PORTION CONTAINS ADDRESSES OF THE DISK WHERE PROGRAMS *
;     NEEDED BY THE DBA,RETRIEVAL PROGRAMS AND UPDATE PROGRAMS ARE    *
;     STORED.                                                          *
;**************************************************************************
;**************************************************************************
         .=        130000
         R1=       %1
         R2=       %2
         R3=       %3
         R4=       %4
         R5=       %5
         R6=       %6
         R7=       %7
         MO=       177736
         JMS       R4,WRITE
         WORD      200.,293.,24400
         JMS       R4,WRITE
         WORD      200.,294.,25000
         JMS       R4,WRITE
         WORD      200.,295.,25400
         JMS       R4,WRITE
         WORD      200.,296.,26000
         JMS       R4,WRITE
         WORD      200.,297.,26400
         JMS       R4,WRITE
         WORD      200.,298.,27000
         JMS       R4,WRITE
         WORD      196.,1.27400 .
         JMS       R4,WRITE
         WORD      196.,2.30000
         JMS       R4,WRITE
         WORD      196.,3.30400
         STOP
WRITE:   TSB       #200.@#177456
         BRZS      WRITE
         TSR       (R4)+.@#177452
         TSR       (R4)+.@#177444
         TSR       (R4)+.@#177460
         TSR       #-128..@#177462
         TSR       #4113.@#177454
         WAIT
SENSE:   TSB       #1,@#177456
         BR ZC     SENSE
         TSB       #40000.@#177456
         BRZS      ERR.11
         RTS       R4
ERR.11:  STOP
         .=        24400
VORBLE:  TSR       (R7)+.VVV.1
         TSR       VVV.1.(R7)+
```

```
            CLR         (R7)+
            RTS         R7
VVV.1:      WORD        0
            .=          24500
DVDRHL:     TSR         (R7)+.DDD.1
            TSR         (R7)+.DDD.2
            TSR         DDD.1.(R7)+
            RTS         R7
DDD.1:      WORD        0
DDD.2:      WORD        0
            .=          25000
GIVSPL:     TSR         R5,-(R1)
            TSR         R4,-(R1)
            TSR         R3,-(R1)
            TSR         R2,-(R1)
            TSR         #2,R3
            TSR         (R7)+.R5
LG.0:       TSR         #5,R2
            CLR         MQ
LG.1:       MPY         #10..R4
            BTSR        (R5)+.R4
            ADD         R4,MQ
            DEC         R2
            BRZC        LG.1
            TSR         MQ,(R7)+
            DEC         R3
            BRZC        LG.0
            TSR         (R1)+.R2
            TSR         (R1)+.R3
            TSR         (R1)+.R4
            TSR         (R1)+.R5
            RTS         R7
LG.TT1:     WORD        0
            .=          25400
WORHLG:     TSR         R4,-(R1)
            TSR         R3,-(R1)
            TSR         R2,-(R1)
            TSR         R5,-(R1)
            TSR         R6,-(R1)
            TSR         (R7)+.R5
            TSR         (R7)+.R6
            TSR         #10..R2
            CLR         R3
            CLR         R4
LPWOR:      BTSR        (R5)+.R3
            BTSR        (R6).R4
            ADD         R4,R3
            CMP         R3,#10.
            BRLT        LPW1
            SUB         #10..R3
            LPW1:       BTSR R3.(R6)+
            DEC         R2
            BRZC        LPWOR
            TSR         (R1)+.R6
            TSR         (R1)+.R5
```

```
        TSR     (R1)+,R2
        TSR     (R1)+,R3
        TSR     (R1)+,R4
        RTS     R7
        .=      26000
;*****************************************************************
;    THE FOLLOWING SEGMENT CONTAINS INITIALISING DATA FOR VARIOUS    *
;    VARIABLES AND INITIAL IDENTIFICATION NO. OF DDA ETC.             *
;*****************************************************************
DASC.1: WORD    29.
ISECYL: WORD    196.
ISECTR: WORD    1
ASECYL: WORD    196.
ASECTR: WORD    2
FLAG1:  WORD    0
IONS:   WORD    14.,0,14.
IDNO:   BYTE    60,60,60,60,60,60,60,60,60,60,60,60
ACYL:   WORD    200.,199.,198.,197.,196.
BITMP:  WORD    -1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
        WORD    0,0,0,0,0,0,0,0,0,0,-1
ND:     WORD    2
ND1:    WORD    26162
NR:     WORD    1
NR1:    WORD    26602
NU:     WORD    1
NU1:    WORD    27126
;*****************************************************************
;    THE FOLLOWING SEGMENT CONTAINS INFORMATION ABOUT THE ADDRESSES  *
;    WHERE PROGRAMS CALLED BY THE DDA GO ON THE DISK                 *
;*****************************************************************
        WORD    100.,27400,201.
        WORD    1.,2.,3.,4.,5.,6.,7.,8.,9.,10.
        WORD    33.,34.,35.,36.,37.,38.,39.,40.,41.,42.
        WORD    65.,66.,67.,68.,69.,70.,71.,72.,73.,74.
        WORD    97.,98.,99.,100.,101.,102.,103.,104.,105.,106.
        WORD    129.,130.,131.,132.,133.,134.,135.,136.,137.,138.
        WORD    161.,162.,163.,164.,165.,166.,167.,168.,169.,170.
        WORD    193.,194.,195.,196.,197.,198.,199.,200.,201.,202.
        WOPD    225.,226.,227.,228.,229.,230.,231.,232.,233.,234.
        WORD    257.,258.,259.,260.,261.,262.,263.,264.,265.,266.
        WORD    289.,290.,291.,292.,293.,294.,295.,296.,297.,298.
        WORD    10.,11400,202.
        WORD    1.,2.,3.,4.,5.,6.,7.,8.,9.,10.
        WORD    33.,34.,35.,36.,37.,38.,39.,40.,41.,42.
        WORD    65.,66.,67.,68.,69.,70.,71.,72.,73.,74.
;*****************************************************************
;    THE FOLLOWING SEGMENT CONTAINS INFORMATION ABOUT ADDRESSES      *
;    WHERE RETRIEVAL PROGRAMS ARE STORED ON THE DISK                 *
;*****************************************************************
RR:     WORD    70.,54000,202.
        WORD    97.,98.,99.,100.,101.,102.,103.,104.,105.,106.
        WORD    129.,130.,131.,132.,133.,134.,135.,136.,137.,138.
        WORD    161.,162.,163.,164.,165.,166.,167.,168.,169.,170.
        WORD    193.,194.,195.,196.,197.,198.,199.,200.,201.,202.
        WORD    225.,226.,227.,228.,229.,230.,231.,232.,233.,234.
```

```
        WORD        257.,258.,259.,260.,261.,262.,263.,264.,265.,266.
        WORD        289.,290.,291.,292.,293.,294.,295.,296.,297.,298.
;**********************************************************************
;    THE FOLLOWING SEGMENT CONTAINS INFORMATION ABOUT AREAS OF DISK  *
;    WHERE UTILITY ROUTINES ( SCANNER AND IT'S ROUTINES ) AND OTHER  *
;    TABLES. WHICH NEED TO BE LOADED WITH BOTH RETRIEVAL AND UPDATE  *
;    PROGRAMS ARE STORED.                                            *
;**********************************************************************
        WORD        30.,27400,201.
        WORD        1.,2.,3.,4.,5.,6.,7.,8.,9.,10.
        WORD        33.,34.,35.,36.,37.,38.,39.,40.,41.,42.
        WORD        65.,66.,67.,68.,69.,70.,71.,72.,73.,74.
;**********************************************************************
;    THE FOLLOWING SEGMENT CONTAINS INFORMATION ABOUT AREAS OF DISK  *
;    WHERE UPDATE PROGRAMS ARE STORED                                *
;**********************************************************************
UU:     WORD        70.,54000,195.
        WORD        97.,98.,99.,100.,101.,102.,103.,104.,105.,106.
        WORD        129.,130.,131.,132.,133.,134.,135.,136.,137.,138.
        WORD        161.,162.,163.,164.,165.,166.,167.,168.,169.,170.
        WORD        193.,194.,195.,196.,197.,198.,199.,200.,201.,202.
        WORD        225.,226.,227.,228.,229.,230.,231.,232.,233.,234.
        WORD        257.,258.,259.,260.,261.,262.,263.,264.,265.,266.
        WORD        289.,290.,291.,292.,293.,294.,295.,296.,297.,298.
;**********************************************************************
;    INITIALISED FIRST SECURITY CODES' TABLE DIRECTORY  ( FSECDC )   *
;**********************************************************************
        .=          27400
        WORD        196.,3,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
;**********************************************************************
;    INITIALISED AUGMENTING SECURITY CODES' TABLE DIRECTORY (ASECDC) *
;**********************************************************************
        .=          30000
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
        WORD        -1,0,0,0,0,0,0
```

```
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
        WORD    -1,0,0,0,0,0,0
;*****************************************************************
;   INITIALISED SECTOR OF FIRST SECURITY CODES' TABLE RESULTING IN  *
;   SECURITY CODES 02712345 12345 AND 02912345 12345                *
;*****************************************************************
        .=      30400
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
XX:     WORD    12345.,12345.
        BYTE    0
        BYTE    0,0,0,0,48.
YY:     WORD    12345.,12345.
        BYTE    0
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
        BYTE    0,0,0,0,48.
```

```
BYTE    0,0,0.0.48.
BYTE    0.0,0.0.48.
BYTE    0.0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0.0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0.0,0.0.48.
BYTE    0.0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
BYTE    0,0,0.0.48.
END
```

```
;***************************************************************
;***************************************************************
;     START PROGRAM WHICH IS INCORPORATED UNDER KCM WITH CODE 'DG'    *
;     ( FOR STARTING EXECUTION FROM ADDRESS 20014 WHICH WILL PRINT    *
;     THE SECURITY CODES AS THEY ARE GIVEN FROM THE TELETYPE ) AND    *
;     WITH CODE "RU" (FOR STARTING EXECUTION FROM ADDRESS 20000 WHICH *
;     WILL SUPPRESS PRINTING OF SECURITY CODES AS THEY ARE INPUTTED   *
;     FROM THE TELETYPE) .                                            *
;***************************************************************
;***************************************************************
        .=          20000
        KBD=        0
        TTY=        1
        R1=         %1
        R2=         %2
        R3=         %3
        R4=         %4
        R5=         %5
        R6=         %6
        R7=         %7
        MC=         177736
        VORBLE=     24400
        DVORBL=     24600
        GIVSEC=     25000
        WORBLE=     25400
        DPSC.1=     26000
        ISECYL=     26002
        ISECTR=     26004
        ASECYL=     26006
        ASECTR=     26010
        TSR         #200.AA
        TSR         #200.SIN.0+2
;***************************************************************
;     THE FOLLOWING PROGRAM SEGMENT READS ROUTINES VORBLE.DVORBL.     *
;     GIVSEC.WORBLE AND OTHER INITIAL INFORMATION FROM DISK INTO CORE *
;***************************************************************
ST.1:   TSR         #137740.R1
        JMS         R4,READ
        WORD        200..293..24400
        JMS         R4,READ
        WORD        200..294..25000
        JMS         R4,READ
        WORD        200..295..25400
        JMS         R4,READ
        WORD        200..296..26000
        JMS         R4,READ
        WORD        200..297..26400
        JMS         R4,READ
        WORD        200..298..27000
;***************************************************************
;     THE FOLLOWING SEGMENT ASKS FOR FIRST SECURITY CODE INPUT. IF    *
;     FOUND VALID. IT JUMPS TO DBA'S ROUTINE IF SECURITY CODE IS THAT *
;     OF THE DBA. OTHERWISE IT JUMPS TO THE SEGMENT WHICH ASKS FOR    *
;     AUTHORITY AUGMENTING SECURITY CODE INPUT.                       *
;***************************************************************
```

```
         RESET
         NOP
         NOP
         NOP
         NOP
         NOP
         NOP
         NOP
         NOP
         NOP
         NOP
         SWRITE     TTY,SM2.21
W21:     WAITR      TTY,W21
         SREAD      KBD,SIN.0
SR2:     WAITR      KBD,SR2
         TSR        ISECYL,CYL0
         TSR        ISECTR,SCT0
         JMS        R4,READ
CYL0:    WORD       0
SCT0:    WORD       0
         OFD        SECSP1
         CLR        MQ
         BTSR       SIN.0+6,MQ
         SUB        #60,MQ
         P          #10.,R2
         BTSR       SIN.0+7,R2
         SUB        #60,R2
         ADD        R2,MQ
         MPY        #10.,R2
         BTSR       SIN.0+8.,R2
         SUB        #60,R2
         ADD        MQ,R2
         TSR        R2,R6
         TST        R6
         BRLE       ST.4
         CMP        R6,#918.
         BRGT       ST.4
         DEC        R2
         CLR        MQ
ST.1.3:  CMP        R2,#51.
         BRLT       ST.1.4
         INC        MQ
         SUB        #51.,R2
         BRN        ST.1.3
ST.1.4:  MPY        #14.,R3
         TSR        MQ,SEC.01
         TSR        MQ,R3
         TSR        #10.,R5
         CLR        R4
ST.1.1:  BTSR       SIN.0+8.(R5),R4
         SUB        #60,R4
         BTSR       R4,SIN.0+8.(R5)
         DEC        R5
         BRZC       ST.1.1
         TST        SECSP1(R3)
```

```
         BRGE      ST.2
         JMP       ST.4
ST.2:    TSR       SECSP1(R3),CYL1
         TSR       SECSP1+2(R3),SCT1
         JMS       R4,READ
CYL1:    WORD      0
SCT1:    WORD      0
         WORD      SECSP2
         TSR       R2,MQ
         MPY       #5,R2
         TSR       MQ,SEC.02
         TSR       MQ,R2
         BTSR      SECSP2+4(R2),BYTE1
         BTST      BYTE1
         BRZS      ST.3
         JMP       ST.4
ST.3:    TSR       #SECSP1+4,SWORD1
         ADD       R3,SWORD1
         TSR       #SIN.0+9.,SWORD2
         JMS       R7,WORBLE
SWORD1:  WORD      0
SWORD2:  WORD      0
         TSR       SWORD2,SWORD3
         JMS       R7,GIVSEC
SWORD3:  WORD      0
SWORD4:  .=        .+4
         BCMP      SWORD4,SECSP2(R2)
         BRZC      ST.4
         BCMP      SWORD4+1,SECSP2+1(R2)
         BRZC      ST.4
         BCMP      SWORD4+2,SECSP2+2(R2)
         BRZC      ST.4
         BCMP      SWORD4+3,SECSP2+3(R2)
         BRZC      ST.4
         CMP       R6,DBSC.1
         BRZC      ST.5
         JMP       DBALD
ST.4:    SWRITE    TTY,SME.22
W22:     WAITR     TTY,W22
         JMP       ST.1
;**************************************************   MMMMMMMMMMMMM
;    THE FOLLOWING SEGMENT BUILDS THE USER'S AUTHORITY   CTOR FROM    *
;    AUGMENTING SECURITY CODES GIVEN BY THE USER, IF AN  WRONG CODE   *
;    IS GIVEN AS INPUT, THEN THE FIRST SECURITY CODE OF  HE USER IS   *
;    CANCELLED                                                        *
;**************************************************   *************
ST.5:    TSR       ASECYL,CYL2
         TSR       ASECTR,SCT2
         JMS       R4,READ
CYL2:    WORD      0
SCT2:    WORD      0
         WORD      SECSP1
         TSR       #255.,R4
ST.5.1:  BCLR      SECSP3(R4)
         DEC       R4
```

```
           BRGE        ST.5.1
ST.5.2:    SWRITE      TTY,SME.23
W23:       WAITR       TTY,W23
           SREAD       KBD,SIN.0
SR3:       WAITR       KBD,SR3
           BCMP        SIN.0+6,#'N
           BRZC        ST.5.3
           CLR         SIN.0+2
           JMP         NDBALD
ST.5.3:    CLR         MQ
           BTSR        SIN.0+6,MQ
           SUB         #60,MQ
           MPY         #10.,R2
           BTSR        SIN.0+7,R2
           SUB         #60,R2
           ADD         R2,MQ
           MPY         #10.,R2
           BTSR        SIN.0+8.,R2
           SUB         #60,R2
           ADD         MQ,R2
           CLR         MQ
           TST         R2
           BRLE        ST.9
           CMP         R2,#450.
           BRGT        ST.9
           DEC         R2
ST.5.6:    CMP         R2,#25.
           BRLT        ST.5.7
           INC         MQ
           SUB         #25.,R2
           BRN         ST.5.6
ST.5.7:    MPY         #14.,R3
           TSR         MQ,R3
           CLR         R4
           TSR         #10.,R5
ST.5.4:    BTSR        SIN.0+8.(R5),R4
           SUB         #60,R4
           BTSR        R4,SIN.0+8.(R5)
           DEC         R5
           BRZC        ST.5.4
           TST         SECSP1(R3)
           BRGE        ST.6
           JMP         ST.9
ST.6:      TSR         SECSP1(R3),CYL3
           TSR         SECSP1+2(R3),SCT3
           JMS         R4,READ
CYL3:      WORD        0
SCT3:      WORD        0
           WORD        SECSP2
           TSR         R2,MQ
           MPY         #10.,R2
           TSR         MQ,R2
           TST         SECSP2(R2)
           BRGE        ST.7
           JMP         ST.9
```

```
ST.7:       TSR         #SECSP1+4,SWOR05
            ADD         R3,SWOR05
            TSR         #SIN.0+9.,SWOR06
            JMS         R7,WORBLE
SWOR05:     WORD        0
SWOR06:     WORD        0
            TSR         SWOR06,SWOR07
            JMS         R7,GIVSEC
SWOR07:     WORD        0
SWOR08:     .=          .+4
            BCMP        SWOR08,SECSP2+6(R2)
            BRZC        ST.9
            BCMP        SWOR08+1,SECSP2+7.(R2)
            BRZC        ST.9
            BCMP        SWOR08+2,SECSP2+8.(R2)
            BRZC        ST.9
            BCMP        SWOR08+3,SECSP2+9.(R2)
            BRZC        ST.9
            TSR         SECSP2(R2),CYL4
            TSR         SECSP2+2(R2),DVO.13
            TSR         SECSP2+4(R2),DVO.14
            JMS         R7,DVORBL
DVO.13:     WORD        0
DVO.14:     WORD        0
DVO.15:     WORD        0
            TSR         DVO.15,SCT4
            JMS         R4,READ
CYL4:       WORD        0
SCT4:       WORD        0
            WORD        SECSP2
            TSR         #255.,R4
ST.8:       BSTB        SECSP2(R4),SECSP3(R4)
            DEC         R4
            BRGE        ST.8
            JMP         ST.5.2
;************************************************* *************
;    THE FOLLOWING SEGMENT IS USED TO CANCELL FIRST SEC RITY CODE OF *
;    THE USER WHO ACTS IN AN UNAUTHORISED MANNER                     *
;*************************************************  ************
ST.9:       TSR         ISECYL,CYL5
            TSR         ISECTR,SCT5
            JMS         R4,READ
CYL5:       WORD        0
SCT5:       WORD        0
            WORD        SECSP1
            TSR         SEC.01,R3
            TSR         SECSP1(R3),CYL6
            TSR         SECSP1+2(R3),SCT6
            JMS         R4,READ
CYL6:       WORD        0
SCT6:       WORD        0
            WORD        SECSP2
            TSR         SEC.02,R2
            BTSR        ERBITS,SECSP2+4(R2)
            TSR         CYL6,CYL7
```

```
            TSB        SCT6,SCT7
            JMS        R4,WRITE
 CYL7:      WORD       0
 SCT7:      WORD       0
            WORD       SECSP2
            SWRITE     TTY,SME.22
 W22.1:     WAITR      TTY,W22.1
            STOP
 AA:        WORD       0
 DB:        BCI        %DB%
 STN.0:     WORD       16.,0.16.
            .=         .+16.
 SME.21:    WORD       40.,0.40.
            BYTE       15,12
            BCI        % PLEASE GIVE YOUR FIRST SECURI%
            BCI        %TY CODE %
 SME.22:    WORD       28.,0,28.
            BYTE       15,12
            BCI        % SORRY.UNABLE TO SERVE YOU%
 SME.23:    WORD       60.,0,60.
            BYTE       15,12
            BCI        % PLEASE GIVE YOUR NEXT SECURITY %
            BCI        %CODE(AUTHORITY AUGMENTING)%
 SEC.01:    WORD       0
 SEC.02:    WORD       0
 BYTE1:     BYTE       0,0
;*************************************************************************
;    THE FOLLOWING SEGMENT CONTAINS ROUTINES FOR READING & WRITING    *
;    ON THE DISK                                                         *
;*************************************************************************
 READ:      TSB        #4107,-(R1)
            BRN        RW
 WRITE:     TSB        #4113,-(R1)
 RW:        TSB        #200.@#177456
            BRZS       RW
            TSB        (R4),@#177452
            CMP        (R4)+,#195.
            BRIT       ERR.12
            TSB        (R4)+,@#177444
            TSB        (R4)+,@#177460
            TSB        #-128.,@#177462
            TSB        (R1)+,@#177454
            WAIT
 SENSE:     TSB        #1,@#177456
            BRZC       SENSE
            TSB        #40000.@#177456
            BRZS       ERR.11
            RTS        R4
 ERR.12:    STOP
 ERBITS:    WORD       12.
 ERR.11:    STOP
 SECSP1:    .=         .+256.
 SECSP2:    .=         .+256.
 SECSP3:    .=         .+256.
            STDBA=     75762
```

```
         NDBAST=     54000
         ND=         26146
         ND1=        26150
         NR=         26152
         NR1=        26154
         NU=         26156
         NU1=        26160
;****************************************************  ************
;    THIS SEGMENT LOADS SECURITY,BUILD AND REMOVE PROGR  S ETC.      *
;    NEEDED BY THE DBA AND  THEN JUMPS TO DBA'S ROUTINE              *
;****************************************************  ************
DBALD:     TSR        ND,R2
           TSR        ND1,R3
LD1:       TSR        (R3)+,R4
           TSR        (R3)+,STR8
           TSR        (R3)+,CYL8
LD2:       TSR        (R3)+,SCT8
           JMS        R4,READ
CYL8:      WORD       0
SCT8:      WORD       0
STR8:      WORD       0
           ADD        #400,STR8
           DEC        R4
           BRGT       LD2
           DEC        R2
           BRGT       LD1
           JMP        STDBA
;****************************************************  ************
;    THIS SEGMENT LOADS PROGRAMS FOR RETRIEVAL OR UPDAT  DEPENDING   *
;    UPON USER'S INTEREST & JUMPS TO THE CORRESPONDING   UTINE       *
;****************************************************  ************
NDBALD:    SWRITE     TTY,SME.30
WNR1:      WAITR      TTY,WNR1
           SREAD      KBD,SIN.0
WNR2:      WAITR      KBD,WNR2
           BCMP       SIN.0+6,#'R
           BR7S       RETRVL
           BCMP       SIN.0+6,#'U
           BR7S       UPDATE
           BCMP       SIN.0+6,#'F
           BR7C       NDBALD
           SWRITE     TTY,SME.31
WNR3:      WAITR      TTY,WNR3
           STOP
           NOP
RETRVL:    TSR        NR,R2
           TSR        NR1,R3
           JMP        LD3
UPDATE:    TSR        NU,R2
           TSR        NU1,R3
           SUB        #66.,R3
LD3:       INC        R2
LD3.1:     TSR        (R3)+,R4
           TSR        (R3)+,STR9
           TSR        (R3)+,CYL9
```

```
LD4:      TSR       (R3)+.SCT9
          JMS       R4,READ
CYL9:     WORD      0
SCT9:     WORD      0
STR9:     WORD      0
          ADD       #400.STR9
          DEC       R4
          BRGT      LD4
          DEC       R2
          BRGT      LD3.1
          JMP       NDRAST
SME.30:   WORD      18.,0.18.
          BYTE      15,12
          BCI       % SPECIFY THE JOB%
SME.31:   WORD      12.,0.12.
          BYTE      15,12
          BCI       % GOOD BYE %
;*****************************************************   ************
;     THE FOLLOWING ROUTINE IS USED TO CHECK WHETHER USE    S REQUEST    *
;     FALLS WITHIN HIS AUTHORITY. IF NOT, HIS FIRST SECU    TY CODE IS   *
;     CANCELLED                                                          *
;*****************************************************   ************
          .=        24200
CHKSEC:   TSR       R3,-(R1)
          TSR       R2,-(R1)
          CLR       R2
          CLR       R3
SL.1:     BCLB      SECSP3(R2),SECSP1(R2)
          BTSR      SECSP1(R2),R3
          TST       R3
          BRZC      SL.2
          INC       R2
          CMP       R2,#256.
          BRLT      SL.1
          TSR       (R1)+.R2
          TSR       (R1)+.R3
          RTS       R7
SL.2:     TSR       #3,ERBITS
          JMP       ST.9
          END
```

```
;******************************************
;******************************************
;     PRINTS PROGRAM WHICH IS USED TO PRINT ALL SECURITY TABLES & ALSO*
;     AUTHORITY VECTORS AS REQUESTED BY THE DBA                       *
;******************************************
;******************************************
        .=          70000
        R1=         %1
        R2=         %2
        R3=         %3
        R4=         %4
        R5=         %5
        R6=         %6
        R7=         %7
        MO=         177736
        KBD=        0
        TTY=        1
        PRN=        6
        ISFCYL=     26002
        ISFCTR=     26004
        ASFCYL=     26006
        ASFCTR=     26010
        DVORBL=     24600
        SFCSP1=     22170
        SFCSP2=     22570
        SFCSP3=     23170
        READ=       022060
        WRITE=      022066
        EXIT=       76214
PRINTS: TSR         R7,-(R1)
        TSR         R6,-(R1)
        TSR         R5,-(R1)
        TSR         R4,-(R1)
        TSR         R3,-(R1)
        TSR         R2,-(R1)
        TSR         R1,SSAVEP
        RESET
S.71:   SWRITE      TTY,SME.14
W14:    WAITR       TTY,W14
        SREAD       KBD,SIN.4
WRP1:   WAITR       KBD,WRP1
        CMP         SIN.4+6,#"PR
        BR7C        S.72
        TSR         PRNTR,INPUTP
        BRN         S.73
S.72:   CMP         SIN.4+6,#"TT
        BR7C        S.71
        TSR         TELTYP,INPUTP
        TSR         #5015,TBF1
        TSR         #5015,TBF2
        TSR         #5015,TBF3
        TSR         #5015,TBF4
        TSR         #5015,TBF5
        TSR         #5015,TBF6
        TSR         #5015,TBF7
```

```
         TSR        #5015.TBF8
         TSR        #5015.TBF9
         TSR        #5015.TBF10
S.73:    INIT       PRN,INPUTP
         SWRITE     TTY,SME.15
W15:     WAITR      TTY,W15
         SREAD      KBD,SIN.4
         WRR2:      WAITR KBD.WRR2
         BCMP       SIN.4+6.#'Y
         BRZS       S.74
         JMP        S.88
S.74:    TSR        ISECYL.CYL.41
         TSR        ISECTR.SCT.41
         JMS        R4,READ
CYL.41:  WORD       0
SCT.41:  WORD       0
         WORD       SECSP1
         CLR        R6
         SWRITE     PRN,PBF1
WP1:     WAITR      PRN,WP1
S.P.1:   SWRITE     PRN,PBF10
WP2:     WAITR      PRN,WP2
         SWRITE     PRN,PBF2
WP3:     WAITR      PRN,WP3
         SWRITE     PRN,PBF10
WP4:     WAITR      PRN,WP4
         TSR        #-14..R2
         CLR        PCOUNT
         CLR        R3
S.P.11:  TSR        #20040.PBF3+36.(R3)
         ADD        #2,R3
         CMP        R3,#70.
         BRZC       S.P.11
S.75:    INC        PCOUNT
         CMP        PCOUNT.#19.
         BRZS       S.76
         ADD        #14..R2
         TST        SECSP1(R2)
         BRLT       S.75
         JMS        R7,POWR
         WORD       2
         WORD       PCOUNT
         WORD       PBF3+47.
         TSR        SECSP1(R2).PTEMP
         JMS        R7,POWR
         WORD       3
         WORD       PTEMP
         WORD       PBF3+58.
         TSR        SECSP1+2(R2).PTEMP
         JMS        R7,POWROC
         WORD       PTEMP
         WORD       PBF3+70.
         TSR        #SECSP1+4.PTEMP
         ADD        R2,PTEMP
         JMS        R7,COPC
```

```
        WORD    10.
        WORD    PTEMP
        WORD    PBF3+83.
        SWRITE  PRN,PBF3
WP5:    WAITR   PRN,WP5
        BRN     S.75
S.76:   TST     R6
        BRZS    S.P.2
        JMP     S.90
S.P.2:  TSR     #-14.,R2
        TSR     #19.,R3
        SWRITE  PRN,PBF4
WP6:    WAITR   PRN,WP6
        SWRITE  PRN,PBF10
WP7:    WAITR   PRN,WP7
        SWRITE  PRN,PBF5
WP8:    WAITR   PRN,WP8
        SWRITE  PRN,PBF10
WP9:    WAITR   PRN,WP9
        CLR     R4
S.P.12: TSR     #20040,PBF3+36.(R4)
        ADD     #2,R4
        CMP     R4,#70.
        BRZC    S.P.12
        CLR     R5
S.77:   ADD     #14.,R2
        DEC     R3
        BRZC    S.P.15
        JMP     S.85
S.P.15: TST     SECSP1(R2)
        BRLT    S.77
        TSR     SECSP1(R2),CYL.42
        TSR     SECSP1+2(R2),SCT.42
        JMS     R4,READ
CYL.42: WORD    0
SCT.42: WORD    0
        WORD    SECSP2
        TSR     #18.,PCOUNT
        SUB     R3,PCOUNT
        TSR     PCOUNT,MQ
        MPY     #51.,PCOUNT
        TSR     MQ,PCOUNT
        TSR     #-5,R4
S.7d:   INC     PCOUNT
        ADD     #5,R4
        CMP     R4,#250.
        BRGT    S.77
        BTSR    SECSP2+4(R4),BYT4
        BCLB    BYT1,BYT4
        BCMP    BYT4,#48.
        BRZS    S.78
        BTSR    SECSP2+4(R4),BYT4
        BCLB    BYT2,BYT4
        BCMP    BYT4,#12.
        BRZC    S.79
```

```
          TSR       ILLGLE.PBF3+46.(R5)
          TSR       ILLGLE+2.PBF3+48.(R5)
          TSR       ILLGLE+4.PBF3+50.(R5)
          BRN       S.P.13
S.79:     BTSR      SECSP2+4(R2).BYT4
          BCLR      BYT3.BYT4
          BCMP      BYT4.#3
          BRZC      S.80
          TSR       MORASK.PBF3+46.(R5)
          TSR       MORASK+2.PBF3+48.(R5)
          TSR       MORASK+4.PBF3+50.(R5)
          BRN       S.P.13
S.80:     TSR       #20040.PBF3+46.(R5)
          TSR       #20040.PBF3+48.(R5)
          TSR       #20040.PBF3+50.(R5)
S.P.13:   BTSR      SECSP2(R4).PTEMP
          BTSR      SECSP2+1(R4).PTEMP+1
          JMS       R7,POWR
          WORD      5
          WORD      PTEMP
S.81:     WORD      PBF3+57.
          BTSR      SECSP2+2(R4).PTEMP
          BTSR      SECSP2+3(R4).PTEMP+1
          JMS       R7,POWR
          WORD      5
          WORD      PTEMP
S.82:     WORD      PBF3+62.
          JMS       R7,POWR
          WORD      3
          WORD      PCOUNT
S.83:     WORD      PBF3+54.
          INC       R6
          CMP       R6,#1
          BRZC      S.84
          ADD       #29..S.81
          ADD       #29..S.82
          ADD       #29..S.83
          TSR       #28..R5
          BRN       S.78
S.84:     SUB       #29..S.81
          SUB       #29..S.82
          SUB       #29..S.83
          CLR       R5
          CLR       R6
          SWRITE    PRN,PBF3
WP10:     WAITR     PRN,WP10
          BRN       S.78
S.85:     TST       R6
          BRZS      S.88
          TSR       #25..R2
S.86:     DEC       R2
          BRZS      S.87
          BTSR      #40,PBF3+73.(R2)
          BRN       S.86
S.87:     SWRITE    PRN,PBF3
```

```
WP11:     WAITR     PRN,WP11
S.88:     SWRITE    TTY,SME.16
W16:      WAITR     TTY,W16
          SREAD     KBD,SIN.4
WRP3:     WAITR     KBD,WRP3
          BCMP      SIN.4+6.#'Y
          BRZS      S.89
          JMP       ENDPRI
S.89:     TSR       #1,R6
          TSR       ASECYL.CYL.43
          TSR       ASECTR,SCT.43
          JMS       R4,READ
CYL.43:   WORD      0
SCT.43:   WORD      0
          WORD      SECSP1
          SWRITE    PRN,PBF6
WP12:     WAITR     PRN,WP12
          JMP       S.P.1
S.90:     SWRITE    TTY,SME.17
W17:      WAITR     TTY,W17
          SREAD     KBD,SIN.4
WRP4:     WAITR     KBD,WRP4
          CLR       R6
          BTSR      SIN.4+6.R6
          SUB       #60,R6
          TSR       R6,MQ
          MPY       #10.,R6
          BTSR      SIN.4+7,R6
          SUB       #60,R6
          ADD       R6,MQ
          MPY       #10.,R6
          BTSR      SIN.4+8.,R6
          SUB       #60,R6
          ADD       MQ,R6
          TST       R6
          BRLT      S.90
          CMP       R6,#256.
          BRLE      S.91
          TSR       #256.,R6
S.91:     SWRITE    PRN,PBF7
WP121:    WAITR     PRN,WP121
          SWRITE    PRN,PBF10
WP13:     WAITR     PRN,WP13
          TSR       #-14.,R2
          TSR       #19.,R3
          CLR       R4
S.P.14:   TSR       #20040,PBF3+36.(R4)
          ADD       #2,R4
          CMP       R4,#70.
          BRZC      S.P.14
S.92:     ADD       #14.,R2
          DEC       R3
          BRZS      ENDPRI
          TST       SECSP1(R2)
          BRLT      S.92
```

```
            TSR         SECSP1(R2),CYL.44
            TSR         SECSP1+2(R2),SCT.44
            JMS         R4,READ
CYL.44:     WORD        0
SCT.44:     WORD        0
            WORD        SECSP2
            TSR         #18.,PCOUNT
            SUB         R3,PCOUNT
            TSR         PCOUNT,MU
            MPY         #25.,PCOUNT
            TSR         MU,PCOUNT
            TSR         #-10.,R4
            TSR         #26.,R5
S.93:       DEC         R5
            BRZS        S.92
            ADD         #10.,R4
            INC         PCOUNT
            TST         SECSP2(R4)
            BRLT        S.93
            TSR         SECSP2(R4),CYL.45
            TSR         SECSP2+2(R4),DVO.10
            TSR         SECSP2+4(R4),DVO.11
            JMS         R7,DVORBL
DVO.10:     WORD        0
DVO.11:     WORD        0
DVO.12:     WORD        0
            TSR         DVO.12,SCT.45
            JMS         R4,READ
CYL.45:     WORD        0
SCT.45:     WORD        0
            WORD        SECSP3
            JMS         R7,POWR
            WORD        3
            WORD        CYL.45
            WORD        PBF8+79.
            JMS         R7,POWROC
            WORD        SCT.45
            WORD        PBF8+94.
            TSR         SECSP2+6(R4),PTEMP
            JMS         R7,POWR
            WORD        5
            WORD        PTEMP
            WORD        PBF8+55.
            TSR         SECSP2+8.(R4),PTEMP
            JMS         R7,POWR
            WORD        5
            WORD        PTEMP
            WORD        PBF8+60.
            TSR         PCOUNT,PTEMP
            JMS         R7,POWR
            WORD        3
            WORD        PTEMP
            WORD        PBF8+52.
            SWRITE      PRN,PBF8
WP14:       WAITR       PRN,WP14
```

```
         SWRITE    PRN, PBF9
WP13:    WAITR     PRN,WP15
         SWRITE    PRN,PBF10
WP14:    WAITR     PRN,WP16
         TSR       R6,NUMBPR
         JMS       R7,PRISEC
NUMBPR:  WORD      0
         WORD      SECSP3
         WORD      PBF3+41.
         JMP       S.93
ENDPRI:  TSR       SSAVEP,R1
         TSR       (R1)+,R2
         TSR       (R1)+,R3
         TSR       (R1)+,R4
         TSR       (R1)+,R5
         TSR       (R1)+,R6
         TSR       (R1)+,R7
         JMP       TERMNT
PBF1:    WORD      100.,0,100.
         BCI       %                                   %
TBF1:    BCI       %                   FIRST      %
         BCI       %SECURITY   CODES'  TABLE     %
         BCI       %DIRECTORY              %
PBF2:    WORD      100.,0,100.
         BCI       %                                   %
TBF2:    BCI       %               S.NO.   CYLINDER%
         BCI       % NO.  SECTOR NO.   ROTATING %
         BCI       %DIGITS            %
PBF3:    WORD      100.,0,100.
         BCI       %                                   %
TBF3:    BCI       %                                   %
         BCI       %                                   %
         BCI       %                  %
PBF4:    WORD      100.,0,100.
         BCI       %                        %
         BYTE      15,12,15,12
TBF4:    BCI       %                                   %
         BCI       %FIRST   SECURITY   CODES'  %
         BCI       %TABLE                %
PBF5:    WORD      100.,0,100.
         BCI       %                                   %
TBF5:    BCI       %               STATUS   SECURITY%
         BCI       % CODE          STATUS    %
         BCI       %SECURITY CODE           %
PBF6:    WORD      100.,0,100.
         BCI       %                        %
         BYTE      15,12,15,12
TBF6:    BCI       %               AUGMENTING    %
         BCI       %SECURITY   CODES'  TABLE     %
         BCI       %DIRECTORY              %
PBF7:    WORD      100.,0,100.
         BCI       %                        %
         BYTE      15,12,15,12
TBF7:    BCI       %      AUGMENTING SECURITY %
         BCI       %CODES' TABLE WITH AUTHORITY %
         BCI       %VECTORS                %
```

```
PBF8:       WORD        100., 0, 100.
            BCI         %                         %
TBF8:       BCI         %     SECURITY CODE=            %
            BCI         %CYLINDER NO.=      %
            BCI         %SECTOR NO.=              %
PBF9:       WORD        100.,0,100.
            BCI         %                              %
TBF9:       BCI         %     CORRESPONDING AUTHORITU %
            BCI         %VECTOR IS AS BELOW:        %
            BCI         %                %
PBF10:      WORD        2,0,2
TBF10:      WORD        2040
SSAVEP:     WORD        0
SIN.4:      WORD        14.,0,14.
            .=          .+14.
PRNTR:      WORD        10
INPUTP:     WORD        0
TELTYP:     WORD        2
PTEMP:      WORD        0
PCOUNT:     WORD        0
BYT1:       BYTE        -49.
BYT2:       BYTE        -13.
BYT3:       BYTE        -4
BYT4:       BYTE        0.
ILLGLE:     BCI         %ILLGLE%
MORASK:     BCI         %MORASK%
SME.14:     WORD        64.,0,64.
            BYTE        15,12
            BCI         %  SPECIFY THE DEVICE WHERE%
            BCI         % SECURITY TABLES ARE TO BE PRINTED   %
SME.15:     WORD        56.,0,56.
            BYTE        15,12
            BCI         %  DO YOU WANT TO PRINT%
            BCI         % FIRST SECURITY CODES' TABLES?   %
SME.16:     WORD        60.,0,60.
            BYTE        15,12
            BCI         %  DO YOU WANT TO PRINT AUG%
            BCI         %MENTING SECURITY CODES' TABLES? %
SME.17:     WORD        54.,0,54.
            BYTE        15,12
            BCI         % GIVE NO. OF FIELDS IN AUTHORITY%
            BCI         % VECTORS IN 3 DIGITS%
;*****************************************************************
;     THIS ROUTINE PRINTS A SECTOR OF AUTHORITY VECTOR & IS CALLED BY *
;     THE PRINTS ROUTINE .                                        *
;*****************************************************************
PRISEC:     TSR         R5,-(R1)
            TSR         R4,-(R1)
            TSR         R3,-(R1)
            TSR         R2,-(R1)
            TSR         (R7)+,R2
            TSR         (R7)+,R3
            CLR         PDL1
            TSR         (R7)+,STPB
PRLO:       TSR         #20.,R4
            TSR         STPB,R5
```

```
PRL1:     BTSR      (R3)+.BYT5
          BTSR      BYT5.BYT6
          BCLB      BYT7.BYT5
          BCLB      BYT8.BYT6
          BCMP      BYT5.#9.
          BRGT      PRL2
          BTSR      BYT5.PDL1
          ADD       #60,PDL1
          BRN       PRL3
PRL2:     BTSR      BYT5.PDL1
          ADD       #67,PDL1
PRL3:     BCLR      BYT5
          LSL       BYT6
          LSL       BYT6
          LSL       BYT6
          LSL       BYT6
          BTSR      PDL1.BYT6
          BCMP      BYT5.#9.
          BRGT      PRL4
          BTSR      BYT5.PDL1
          ADD       #60,PDL1
          BRN       PRL5
PRL4:     BTSR      BYT5.PDL1
          ADD       #67,PDL1
PRL5:     BTSR      PDL1.(R5)+
          BTSR      BYT6.(R5)+
          BTSR      #40,(R5)+
          DEC       R2
          BRLE      PRL6
          DEC       R4
          BR7C      PRL1
          SWRITE    PRN,PBF3
WP17:     WAITR     PRN,WP17
          BRN       PRL0
PRL6:     DEC       R4
          TSR       R4,MQ
          MPY       #3,R4
          TSR       MQ,R4
PRL7:     BTSR      #40,(R5)+
          DEC       R4
          BRGT      PRL7
          SWRITE    PRN,PBF3
WP18:     WAITR     PRN,WP18
          TSR       (R1)+.R2
          TSR       (R1)+.R3
          TSR       (R1)+.R4
          TSR       (R1)+.R5
          RTS       R7
PDL1:     WORD      0
BYT8:     BYTE      15.
BYT7:     BYTE      -16.
BYT6:     BYTE      0
BYT5:     BYTE      0
          STPB:     WORD 0
;**********************************************************************
```

```
;    COPC.POWROC & POWR ARE A FEW UTILITY ROUTINES  CALLED BY PRINTS *
;    PROGRAM & ARE SELF EXPLANATORY.                                  *
;*********************************************************************
COPC:      TSR        R5,-(R1)
           TSR        R4,-(R1)
           TSR        R3,-(R1)
           TSR        R2,-(R1)
           CLR        R5
           TSR        (R7)+,R2
           TSR        @(R7)+,R3
           TSR        (R7)+,R4
LCP1:      BTSR       (R3)+,R5
           ADD        #60,R5
           BTSR       R5,(R4)+
           DEC        R2
           BRZC       LCP1
           TSR        (R1)+,R2
           TSR        (R1)+,R3
           TSR        (R1)+,R4
           TSR        (R1)+,R5
           RTS        R7
POWROC:    TSR        R5,-(R1)
           TSR        R4,-(R1)
           TSR        R3,-(R1)
           TSR        R2,-(R1)
           TSR        @(R7)+,R2
           TSR        (R7)+,R3
           TSR        R2,R4
           CLR        PW1,R2
           CLR        PW2,R4
           BTSR       #60,(R3)+
           ASR        R2
           ASR        R2
           ASR        R2
           ASR        R2
           ASR        R2
           ADD        #60,R2
           BTSR       R2,(R3)+
           BTSR       #',,(R3)+
           CMP        R4,#10.
           BRZS       PP1
           ADD        #60,R4
           BTSR       #60,(R3)+
           BTSR       R4,(R3)+
           BRN        PP2
PP1:       BTSR       #61,(R3)+
           BTSR       #60,(R3)+
PP2:       TSR        (R1)+,R2
           TSR        (R1)+,R3
           TSR        (R1)+,R4
           TSR        (R1)+,R5
           RTS        R7
PW1:       WORD       -481.
PW2:       WORD       -32.
POWR:      TSR        R2,-(R1)
```

```
        TSR     R4,-(R1)
        TSR     R6,-(R1)
        TSR     (R7)+.R2
        TSR     @(R7)+,R4
        TSR     (R7)+.XT
        ADD     R2,XT
LPP.1:  TST     R2
        BRZS    RTNU
        DEC     R2
        DEC     XT
        TSR     R4,MQ
        CLR     R4
        DIV     #10..R4
        ADD     #60.R4
        BTSR    R4.@XT
        TSR     MQ.R4
        BRN     LPP.1
RTNU:   TSR     (R1)+.R6
        TSR     (R1)+.R4
        TSR     (R1)+,R2
        RTS     R7
XT:     WORD    0
;**********************************************************************
;**********************************************************************
;    TERMNT PROGRAM WHICH PUTS VARIABLE CORE SECURITY DATA BACK ON    *
;    AND FINISHES THE JOB                                             *
;**********************************************************************
;**********************************************************************
TERMNT: RESET
        JMS     R4,WRITE
        WORD    200..296..26000
        SWRITE  1,TMES
WT:     WAITR   1,WT
        STOP
TMES:   WORD    10..0.10.
        BYTE    15,12
        BCI     %GOOD BYE%
        END
```

```
;***********************************************************************
;***********************************************************************
;    THE FOLLOWING IS THE DBA'S PROGRAM WHICH ASKS THE DBA FOR HIS    *
;    IDENTIFICATION & IF VALID, DOES THE JOBS REQUESTED BY HIM        *
;***********************************************************************
;***********************************************************************
          .=        75762
          KBD=      0
          TTY=      1
          MO=       177736
          SN=       5
          PRN=      6
          R1     =  %1
          R2=       %2
          R3=       %3
          R4=       %4
          R5=       %5
          R6=       %6
          R7=       %7
          TERMNT=   75646
          PRINTS=   70000
          MODIFY=   104100
          INTLZE=   102400
          FLAG1=    26012
          IONS=     26014
          IDNO=     26022
          AA=       21576
RESET
DBA:      SWRITE    TTY,SMES.1
W1:       WAITR     TTY,W1
          TSR       AA,SIN.1+2
          SREAD     KBD,SIN.1
WR1:      WAITR     KBD,WR1
S.1:      TSR       #12.,R2
          TSR       #IDNO,R3
          TSR       #SIN.1+6,R4
S.2:      BCMP      (R3)+,(R4)+
          BRZC      SERROR
          DEC       R2
          BRZC      S.2
          BCMP      (R4),#'Y
          BRZC      S.3
          SWRITE    TTY,SMES.4
W2:       WAITR     TTY,W2
          TSR       AA,IONS+2
          SREAD     KBD,IONS
WR2:      WAITR     KBD,WR2
          CLR       IONS+2
          CLR       SIN.1+2
S.3:      BTST      FLAG1
          BRZS      S.4
          BTSR      FLAG1,SMES.3+41.
          ADD       #30000,SMES.3+40.
          SWRITE    TTY,SMES.3
W3:       WAITR     TTY,W3
```

```
          BCMP      FLAG1.#9.
          BRZS      SERROR
          BCLR      FLAG1
S.4:      SWRITE    TTY,SMES.5
W4:       WAITR     TTY,W4
          BRN       S.4.2
S.4.1:    SWRITE    TTY,SME.6
W4.1:     WAITR     TTY,W4.1
S.4.2:    SREAD     KBD,SIN.1
WR3:      WAITR     KBD,WR3
          TSR       FNCTN,R2
          TSR       #CUDA.1.R3
L.1:      TSR       #SIN.1+6.R4
          TSR       (R3)+,R6
          TSR       LNGTJ,R5
L.2:      BCMP      (R6)+,(R4)+
          BRZC      NXT
          DEC       R5
          BRZC      L.2
          LSL       R2
          JMP       @BR-2(R2)
NXT:      DEC       R2
          BRZS      S.4
          BRN       L.1
SERROR:   BINC      FLAG1
          BCMP      FLAG1,#9.
          BRLE      S.5
          BTSR      #9.,FLAG1
S.5:      SWRITE    TTY,SMES.2
W5:       WAITR     TTY,W5
          JMP       TERMNT
SIN.1:    WORD      16.,0.16.
          .=        .+16.
FNCTN:    WORD      7
LNGTJ:    WORD      6
SMES.1:   WORD      44.,0.44.
          BYTE      15,12
          BCI       % PLEASE GIVE YOUR IDENTIFICATION%
          BCI       % NUMBER   %
SMES.2:   WORD      30.,0.30.
          BYTE      15,12
          BCI       % SORRY.UNABLE TO SERVE YOU   %
SMES.3:   WORD      42.,0.42.
          BYTE      15,12
          BCI       % ILLEGAL REFERENCE MADE %
          BCI       %EARLIER    TIMES%
SMES.4:   WORD      34.,0.34.
          BYTE      15,12
          BCI       % GIVE NEW IDENTIFICATION%
          BCI       % NUMBER %
SMES.5:   WORD      18.,0.18.
          BYTE      15,12
          BCI       % SPECIFY THE JOB%
SME.6:    WORD      30.,0.30.
          BYTE      15,12
```

```
          BCI          % JOB OVER,SPECIFY NEXT JOB  %
CODA.1:   WORD         CD1,CD2,CD3,CD4,CD5,CD6,CD7
CD1:      BCI          %INTLZE%
CD2:      BCI          %MODIFY%
CD3:      BCI          %REMOVE%
CD4:      BCI          %TERMNT%
CD5:      BCI          %PRINTS%
CD6:      BCI          %CCCCCC%
CD7:      BCI          %RELBLD%
BR:       WORD         RELBLD
          WORD         CCCCCC
          WORD         PRINTS
          WORD         TERMNT
          WORD         REMOVE
          WORD         MODIFY
          WORD         INTLZE
          RELBLD=      60040
          CCCCCC=      56630

          CCCCCC=      56630
          REMOVE=      66400
;*******************************************************   ************
:    THE FOLLOWING ROUTINE IS USED TO ASSIGN A SECTOR O  SECURITY     *
:    SPACE TO CALLING PROGRAM. CALL IS  JMS R7.ALOCTS &  T RETURNS    *
:    CYL. NO. & SECTOR & SURFACE NO. TO THE NEXT TWO WO  S            *
;*******************************************************   ************
          .=           77106
          ACYL=        26036
          BITMP=       26050
ALOCTS:   TSR          R6,-(R1)
          TSR          R5,-(R1)
          TSR          R4,-(R1)
          TSR          R3,-(R1)
          TSR          R2,-(R1)
          TSR          R1,SSAVE1
          RESET
          JMS          R2,RNDY1
R:        WORD         0
          TSR          R,MQ
          CLR          R
          DIV          #62..R
          ASR          R
          LSL          R
S.11:     TSR          R,R2
          TSR          #62..R3
          CLR          R6
S.12:     TSR          #16..R4
          TSR          #1.R5
S.13:     TSB          R5,BITMP(R2)
          BRZS         GOTONE
          LSL          R5
          INC          R6
          DEC          R4
          BRZC         S.13
          ADD          #2,R2
          CMP          R2,#62.
          BRZC         S.14
```

```
            CLR         R2
S.14:       SUB         #2,R3
            BRZC        S.12
            SWRITE      TTY,SMES.6
W6:         WAITR       TTY,W6
            TSR         EMPTYS,(R7)+
            ADD         #2,R7
            BRN         ES.2
GOTUM:      STR         R5,BITMP(R2)
            ADD         R,R
            ADD         R,R
            ADD         R,R
            ADD         R6,R
            CMP         R,#496.
            BRLT        S.15
            SUB         #496.,R
S.15:       TSR         R,MQ
            CLR         R
            DIV         #100.,R
            LSL         MQ
            TSR         MQ,R2
            TSR         ACYL(R2),(R7)+
            TSR         R,MQ
            CLR         R
            DIV         #10.,R
            MPY         #32.,R5
            ADD         MQ,R
            INC         R
            TSR         R,(R7)+
ES.2:       TSR         SSAVE1,R1
            TSR         (R1)+,R2
            TSR         (R1)+,R3
            TSR         (R1)+,R4
            TSR         (R1)+,R5
            TSR         (R1)+,R6
            RTS         R7
SSAVE1:     WORD        0
EMPTYS:     WORD        -1
SMES.6:     WORD        42.,0.42.
            BYTE        15,12
            BCI         % NO SECTOR AVAILABLE IN %
            BCI         %SECURITY SPACE   %
;**********************************************************************
;     FOLLOWING ROUTINE RELEASES A SECTOR OF DISK SECURITY SPACE WITH *
;     CALL  JMS R7,RELSEC & NEXT TWO WORDS CONTAINING THE ADDRESS OF  *
      THE SECTOR TO BE RE EASED .                                   ; *
;**********************************************************************
RELSEC:     TSR         R6,-(R1)
            TSR         R5,-(R1)
            TSR         R4,-(R1)                                ) )
            TSR         R3,-(R1)
            TSR         R2,-(R1)
            TSR         R1,SSAVE2
            RESET
            TSR         #0,R2
```

```
          TSR       (R7)+,CYLSEC
          TSR       (R7)+,SECTRS
          TSR       #0,R3
S.21:     CMP       CYLSEC,ACYL(R3)
          BRZS      S.22
          ADD       #2,R3
          INC       R2
          CMP       R2,#5
          BRZS      S.24
          BRN       S.21
S.22:     TSR       SECTRS,MQ
          TSR       #0,R3
          DIV       #32.,R3
          DEC       R3
          MPY       #10.,R4
          ADD       MQ,R3
          TSR       R2,MQ
          MPY       #100.,R2
          ADD       R3,MQ
          CMP       MQ,#495.
          BRGT      S.24
          CLR       R3
          DIV       #16.,R3
          INC       R3
          TSR       MQ,R4
          ADD       R4,R4
          TSR       #1,SSSSS1
S.23:     DEC       R3
          NOP
          BRZS      S.23.1
          LSL       SSSSS1
          BRN       S.23
S.23.1:   CLB       SSSSS1,BITMP(R4)
          NOP
          BRN       ES.3
SSSSS1:   WORD      0
S.24:     SWRITE    TTY,SMES.7
W7:       WAITH     TTY,W7
ES.3:     TSR       SSAVE2,R1
          TSR       (R1)+,R2
          TSR       (R1)+,R3
          TSR       (R1)+,R4
          TSR       (R1)+,R5
          TSR       (R1)+,R6
          RTS       R7
SMES.7:   WORD      76.,0,76.
          BYTE      15,12
          BCI       % SECTOR TO BE RELEASED OUT OF %
          BCI       %RANGE,NO SECTOR RELEASED%
          BCI       %,PROGRAM CONTINUES   %
SSAVE2:   WORD      0
CYLSEC:   WORD      0
SECTRS:   WORD      0
```

```
;*******************************************************************************
;    THIS IS A RANDOM NO. GENERATOR FOR THE ENTIRE SYSTEM                       *
;*******************************************************************************
RNDY1:      TSR         N1,N3
            ADD         N2,N3
            TSR         N2,N1
            TSR         N3,N2
            TSR         N3,(R2)+
            RTS         R2
N1:         WORD        0
N2:         WORD        1
N3:         WORD        0
            END
```

```
;**********************************************************
;***********************************************************
;       UTILITY ROUTINES
;***********************************************************
;***********************************************************
;***********************************************************
          .=          100400
          MC=         177736
          R1=         %1
          R2=         %2
          R3=         %3
          R4=         %4
          R5=         %5
          R6=         %6
          R7=         %7
          KBD=        0
          TTY=        1
          SN=         5
          PRNT=       6
          RDY1=       100154
;***********************************************************
;      THE FOLLOWING ROUTINE IS USED TO GET A CHARACTER OF INPUT FROM  *
;      THE DEVICE WHOSE CODE IS CONTAINED IN INPUT. CALL     JMS R7,GET*
;      & CHARACTER RETURNED IS IN VARIABLE CH.                          *
;**********************************************     *************
GET:      TSR         R4,-(R1)
          TSR         R1,SSAVEG
          BTST        FLAG
          BRZC        S.35
          BTSR        #1,FLAG
          CLR         SAVE1
          CLR         COUNT
          BCMP        INPUT,#1
          BRZC        S.34
          TSR         #2,XTSUB
          BRN         S.35
S.34:     CLR         XTSUB
S.35:     TST         COUNT
          BRZC        S.37
          CLR         SAVE1
S.36:     RESET
          INIT        SN,INPUT
          INIT        PRNT,PRNTR
          SWRITE      TTY,XB
BW:       WAITR       TTY,BW
          SREAD       SN,IN2
WW2:      WAITR       SN,WW2
          SUB         XTSUB,COUNT
          TST         COUNT
          BRLE        S.38
          SWRITE      PRNT,IN2
WW3:      WAITR       PRNT,WW3
S.37:     TSR         SAVE1,R4
          BTSR        IN2+6(R4),CH
          INC         SAVE1
          DEC         COUNT
```

```
            TSR         SSAVEG,R1
            TSR         (R1)+,R4
            RTS         R7
S.38:       SWRITE      TTY,XB
CW:         WAITR       TTY,CW
            SWRITE      TTY,XC
DW:         WAITR       TTY,DW
            SREAD       KBD,III
WIII:       WAITR       KBD,WIII
            BRN         S.36
III:        WORD        2,0,2,0
SSAVEG:     WORD        0
SAVE1:      WORD        0
XTSUB:      WORD        0
FLAG:       BYTE        0
CH:         BYTE        0
INPUT:      BYTE        1
PRNTR:      BYTE        10
CARDIN:     BYTE        7
PAPIN:      BYTE        5
KYBRD:      BYTE        1
PAPOUT:     BYTE        6
XB:         WORD        2,0,2,3407
XC:         WORD        22,0,22
            BYTE        15,12
            BCI         %INPUT NOT READY.%
IN2:        WORD        80.
ST2:        BYTE        0,0
COUNT:      WORD        0
            .=          .+80.
;****************************************************    ************
;    THE FOLLOWING ROUTINE READS A 3 DIGIT INPUT & PUTS    T IN THE     *
;    FOLLOWING WORD AFTER CONVERTING IT TO IT'S BINARY    LUE. CALL IS*
;    JMS R7.GET.3                                                      *
;****************************************************    ************
GET.3:      TSR         R2,-(R1)
            TSR         R3,-(R1)
            TSR         R4,-(R1)
            TSR         #3,R2
            CLR         MQ
GET.31:     JMS         R7,GET
            BCMP        CH,#40
            BRZS        GET.31
            CLR         R3
            BTSR        CH,R3
            SUB         #60,R3
            MPY         #10.,R4
            ADD         R3,MQ
            DEC         R2
            BRZC        GET.31
            TSR         MQ,(R7)+
            TSR         (R1)+,R4
            TSR         (R1)+,R3
            TSR         (R1)+,R2
            RTS         R7
```

```
;***************************************************************  *************
;    THE FOLLOWING ROUTINE GENERATES A 10 DIGIT RANDOM          MBER & PUTS *
;    IT IN A BUFFER WHOSE STARTING ADDRESS FOLLOWS THE          LL TO THIS  *
;    ...TI H   .                                                            *
;***************************************************************  *************
            TSR          R3,-(R1)
            TSR          R2,-(R1)
            TSR          #10.,R3
            TSR          (R7)+,GEN.1
            JMS          R2,RNDY1
RDY:        WORD         0
            CLR          R2
            TSR          RDY,R0
            DIV          #10.,R2
            BTSR         R2,@GEN.1
            INC          GEN.1
            DEC          R3
            BRZC         GENS.1
            TSR          (R1)+,R2
            TSR          (R1)+,R3
            RTS          R7
GEN.1:      WORD         0
;***************************************************************  *************
;    THIS ROUTINE READS A 10 DIGIT INPUT & GENERATES IT          4 WORD      *
;    BINARY EQUIVALENT.                                                      *
;***************************************************************  *************
GET.10:     TSR          R4,-(R1)
            TSR          R3,-(R1)
            TSR          R2,-(R1)
            TSR          #10.,R2
LPGT10:     JMS          R7,GET
            BCMP         CH,#40
            BRZS         LPGT10
            CLR          R3
            BTSR         CH,R3
            SUB          #60,R3
            BTSR         R3,(R7)+
            DEC          R2
            BRZC         LPGT10
            TSR          (R1)+,R2
            TSR          (R1)+,R3
            TSR          (R1)+,R4
            RTS          R7
;***************************************************************  *************
;    THIS ROUTINE READS THE AUTHORITY VECTOR SPECIFICAT          N OF ANY    *
;    MODIFICATION CARD & BUILDS IT'S EQUIVALENT AUTHORI          VECTOR      *
;***************************************************************  *************
AUTHSC:     TSR          R4,-(R1)
            TSR          R3,-(R1)
            TSR          R2,-(R1)
            TSR          (R7)+,R4
            TSR          R4,R2
            ADD          #256.,R4
            TSR          #128.,R3
AU.1:       CLR          (R2)+
```

```
            DEC         R3
            BRZC        AU.1
            TSR         R4,R3
            SUB         #257.,R3
AU.2:       JMS         R7,GET
            BCMP        CH,#'#
            BRZC        AU.2
AU.2.1:     JMS         R7,AUT.1
AU01:       WORD        0
            CMP         AU01,#1
            BRLT        AU.4
            CMP         AU01,#256.
            BRGT        AU.4
            TSR         AU01,R2
            ADD         R3,R2
AU.3:       JMS         R7,AUT.2
AU02:       WORD        0
            BTSR        AU02,(R2)+
            BCMP        R2,R4
            BRZS        AUTEND
            BCMP        AU02+1,#'.
            BRZS        AUTEND
            BCMP        AU02+1,#'#
            BRZC        AU.3
            BRN         AU.2.1
AU.4:       SWRITE      TTY,SME.13
W13:        WAITR       TTY,W13
AUTEND:     TSR         (R1)+,R2
            TSR         (R1)+,R3
            TSR         (R1)+,R4
            RTS         R7
SME.13:     WORD        118.,0,118.
            BYTE        15,12
            BCI         % COMMAND ERROR IN AUTHORITY %
            BCI         %VECTOR MODIFICATION.PROGRAM %
            BYTE        15,12
            BCI         % CONTINUES AFTER DELETING PART%
            BCI         % OF COMMAND FOLLOWING ERROR %
AUT.1:      TSR         R2,-(R1)
            CLR         MQ
AUT.12:     JMS         R7,GET
            BCMP        CH,#40
            BRZS        AUT.12
            BCMP        CH,#',
            BRZS        AUT.13
            MPY         #10.,R2
            BTSR        CH,R2
            SUB         #60,R2
            ADD         R2,MQ
            BRN         AUT.12
AUT.13:     TSR         MQ,(R7)+
            TSR         (R1)+,R2
            RTS         R7
AUT.2:      TSR         R2,-(R1)
            CLR         MQ
```

```
AUT.21:   JMS       R7,GET
          BCMP      CH,#40
          BRZS      AUT.21
          BCMP      CH,#'.
          BRZS      AUT.22
          BCMP      CH,#'#
          BRZS      AUT.23
          BCMP      CH,#',
          BRZS      AUT.24
          MPY       #10,R2
          BTSR      CH,R2
          SUB       #60,R2
          ADD       R2,MQ
          BRN       AUT.21
AUT.22:   TSR       MQ,R2
          BTSR      R2,(R7)+
          BTSR      #'.,(R7)+
          BRN       AUT.25
AUT.23:   TSR       MQ,R2
          BTSR      R2,(R7)+
          BTSR      #'#,(R7)+
          BRN       AUT.25
AUT.24:   TSR       MQ,R2
          BTSR      R2,(R7)+
          BCLR      (R7)+
AUT.25:   TSR       (R1)+,R2
          RTS       R7
          END
```

```
;*****************************************************************
;*****************************************************************
;     INTLZE PROGRAM WHICH INITIALISES THE FIRST SECURITY CODE'S TABLE*
;     TO CONTAIN ONLY DBA'S CODE & MAKES AUGMENTING SECURITY CODES    *
;     TABLE EMPTY DEPENDING UPON DBA'S REQUEST.                       *
;*****************************************************************
;*****************************************************************
        .=              102400
        R1=             %1
        R2=             %2
        R3=             %3
        R4=             %4
        R5=             %5
        R6=             %6
        R7=             %7
        KBD=            0
        TTY=            1
        VORBLF=         24400
        DVORBL=         24600
        READ=           022060
        WRITE=          022066
        DBSC.1=         26000
        ISECYL=         26002
        ISECTR=         26004
        ASECYL=         26006
        ASECTR=         26010
        SECSP1=         22170
        SECSP2=         22570
        EXIT=           76214
        RELSEC=         77550
        ALOCTS=         77106
INTLZE: TSR             R6,-(R1)
        TSR             R5,-(R1)
        TSR             R4,-(R1)
        TSR             R3,-(R1)
        TSR             R2,-(R1)
        TSR             R1,SSAVE3
        RESET
        SWRITE          TTY,SMES.8
W8:     WAITR           TTY,W8
        SREAD           KBD,SIN.2
WR4:    WAITR           KBD,WR4
        BCMP            SIN.2+6,#'Y
        BRZS            FSCINT
        JMP             ASCINT
FSCINT: TSR             ISECYL,CYL.1
        TSR             ISECTR,SCT.1
        JMS             R4,READ
CYL.1:  WORD            0
SCT.1:  WORD            0
        WORD            SECSP1
        TSR             CYL.1,CYL.2
        TSR             SCT.1,SCT.2
        JMS             R7,RELSEC
CYL.2:  WORD            0
```

```
SCT.2:     WORD     0
           JMS      R7,ALOCTS
CYL.3:     WORD     0
SCT.3:     WORD     0
           TSR      CYL.3.ISECYL
           TSR      SCT.3.ISECTR
           TSR      #0,R2
           TSR      #18..R6
S.16:      TST      SECSP1(R2)
           BRGE     S.18
S.17:      ADD      #14..R2
           DEC      R6
           BRZC     S.16
           BRN      S.26
S.18:      TSR      R2,R3
           TST      R2
           BRZS     S.19
           TSR      SECSP1(R2).CYL.4
           ADD      #2,R3
           TSR      SECSP1(R3),SCT.4
           JMS      R7,RELSEC
CYL.4:     WORD     0
SCT.4:     WORD     0
           TSR      #-1,SECSP1(R2)
           BRN      S.17
S.19:      TSR      SECSP1(R2),CYL.5
           ADD      #2,R3
           TSR      SECSP1(R3),SCT.5
           JMS      R4,READ
CYL.5:     WORD     0
SCT.5:     WORD     0
           WORD     SECSP2
           TSR      #4,R4
           TSR      #0,R5
S.20:      INC      R5
           CMP      R5,DBSC.1
           BRZS     S.25
           BTSR     #48..SECSP2(R4)
S.25:      ADD      #5,R4
           CMP      R5,#51.
           BRZC     S.20
           TSR      CYL.5.CYL.6
           TSR      SCT.5.SCT.6
           JMS      R7,RELSEC
CYL.6:     WORD     0
SCT.6:     WORD     0
           JMS      R7,ALOCTS
CYL.7:     WORD     0
SCT.7:     WORD     0
           TSR      CYL.7.CYL.8
           TSR      SCT.7.SCT.8
           JMS      R4,WRITE
CYL.8:     WORD     0
SCT.8:     WORD     0
           WORD     SECSP2
```

```
          TSR       CYL.7.SECSP1(R2)
          TSR       SCT.7.SECSP1(R3)
          BRN       S.17
S.26:     TSR       CYL.3.CYL.9
          TSR       SCT.3.SCT.9
          JMS       R4,WRITE
CYL.9:    WORD      0
SCT.9:    WORD      0
          WORD      SECSP1
ASCINT:   SWRITE    TTY,SMES.9
W9:       WAITR     TTY,W9
          SREAD     KBD,SIN.2
WR9:      WAITR     KBD,WR9
          BCMP      SIN.2+6,#'Y
          BRZC      ES.30
          TSR       ASECYL,CYL.10
          TSR       ASECTR,SCT.10
          JMS       R4,READ
CYL.10:   WORD      0
SCT.10:   WORD      0
          WORD      SECSP1
          TSR       CYL.10,CYL.11
          TSR       SCT.10,SCT.11
          JMS       R7,RELSEC
CYL.11:   WORD      0
SCT.11:   WORD      0
          JMS       R7,ALOCTS
CYL.12:   WORD      0
SCT.12:   WORD      0
          TSR       CYL.12,ASECYL
          TSR       SCT.12,ASECTR
          TSR       #0,R2
          TSR       #18.,TEMI.1
S.27:     TST       SECSP1(R2)
          BRGE      S.29
S.28:     ADD       #14.,R2
          DEC       TEMI.1
          BRZC      S.27
          BRN       S.33
S.29:     TSR       R2,R3
          TSR       SECSP1(R2),CYL.13
          TSR       #-1,SECSP1(R2)
          ADD       #2,R3
          TSR       SECSP1(R3),SCT.13
          JMS       R4,READ
CYL.13:   WORD      0
SCT.13:   WORD      0
          WORD      SECSP2
          TSR       CYL.13,CYL.14
          TSR       SCT.13,SCT.14
          JMS       R7,RELSEC
CYL.14:   WORD      0
SCT.14:   WORD      0
          TSR       #0,R4
          TSR       #25.,TEMI.2
```

```
S.30:     TST       SECSP2(R4)
          BVGE      S.32
S.31:     ADD       #10.,R4
          DEC       TEMI.2
          BRZC      S.30
          BRN       S.28
S.32:     TSR       R4,R5
          TSR       SECSP2(R4),CYL.15
          ADD       #2,R5
          TSR       SECSP2(R5),DVO.1
          ADD       #2,R5
          TSR       SECSP2(R5),DVO.2
          JMS       R7,DVORJL
DVO.1:    WORD      0
DVO.2:    WORD      0
DVO.3:    WORD      0
          TSR       DVO.3,SCT.15
          JMS       R7,RELSEC
CYL.15:   WORD      0
SCT.15:   WORD      0
          BRN       S.31
S.33:     TSR       CYL.12,CYL.16
          TSR       SCT.12,SCT.16
          JMS       R4,WRITE
CYL.16:   WORD      0
SCT.16:   WORD      0
          WORD      SECSP1
ES.30:    TSR       SSAVE3,R1
          TSR       (R1)+,R2
          TSR       (R1)+,R3
          TSR       (R1)+,R4
          TSR       (R1)+,R5
          TSR       (R1)+,R6
          JMP       EXIT
SSAVE3:   WORD      0
TEMI.1:   WORD      0
TEMI.2:   WORD      0
SMES.8:   WORD      52.,0,52.
          BYTE      15,12
          BCI       % DO YOU WANT TO INITIALIZE%
          BCI       % FIRST SECURITY CODES    %
SMES.9:   WORD      54.,0,54.
          BYTE      15,12
          BCI       % DO YOU WANT TO INITIALIZE%
          BCI       % AUTHORITY VECTOR CODES    %
SIN.2:    WORD      2,0,2
          .=        .+2
          END
```

```
;*************************************************************************
;*************************************************************************
;    MODIFY PROGRAM WHICH ACCEPTS DHA'S REQUEST FOR DELETING,ADDING     *
;    OR MODIFYING ANY SECURITY CODE OR AUTHORITY VECTOR.                *
;*************************************************************************
;*************************************************************************
          .=         104100
          FLAG=      100706
          CARDIN=    100712
          KYBRD=     100714
          PAPIN=     100713
          CH=        100707
          SECSP1=    22170
          SECSP2=    22570
          EXIT=      76214
          VORBLE=    24400
          DVORBL=    24600
          READ=      22060
          WRITE=     22066
          ISECYL=    26002
          ISECTR=    26004
          ASECYL=    26006
          ASECTR=    26010
          MO=        177736
          ALOCTS=    77106
          INPUT=     100710
          RELSEC=    77550
          GET.3=     101104
          GET.10=    101262
          GIVSEC=    25000
          WORBLE=    25400
          GENWOR=    101200
          GET=       100400
          AUTHSC=    101340
R1=%1
R2=%2
R3=%3
R4=%4
R5=%5
R6=%6
R7=%7
          KBD=       0
          TTY=       1
MODIFY:   RESET
          SWRITE     TTY,SME.10
W10:      WAITR      TTY,W10
          SREAD      KBD,SIN.3
WR6:      WAITR      KBD,WR6
          BCLR       FLAG
          CMP        SIN.3+6,#"CA
          BRZC       S.41
          BTSR       CARDIN,INPUT
          BRN        S.43
S.41:     CMP        SIN.3+6,#"KY
          BRZC       S.42
```

```
         BTSR        KYBRD,INPUT
         BRN         S.43
S.42:    CMP         SIN,3+6,#"PA
         BRZC        MODIFY
         BTSR        PAPIN,INPUT
S.43:    JMS         R7,GET
         BCMP        CH,#40
         BRZS        S.43
S.44:    BCMP        CH,#'D
         BRZC        S.45
         JMP         S.49
S.45:    BCMP        CH,#'E
         BRZC        S.46
         JMP         S.53
S.46:    BCMP        CH,#'F
         BRZC        S.47
         JMP         EXIT
S.47:    SWRITE      TTY,SMF.11
W11:     WAITR       TTY,W11
S.48:    JMS         R7,GET
S.AU:    BCMP        CH,#'.
         BRZC        S.48
         BRN         S.43
S.49:    JMS         R7,GET
         BCMP        CH,#40
         BRZS        S.49
         BCMP        CH,#61
         BRZS        S.50
         BCMP        CH,#62
         BRZS        S.51
         BRN         S.47
;*********************************************************************
;    THIS SEGMENT DELETES THE FIRST SECURITY CODE AS REQUESTED BY DBA*
;*********************************************************************
S.50:    JMS         R7,GET.3
C.1:     WORD        0
         CMP         C.1,#1
         BRLT        S.47
         CMP         C.1,#918.
         BRGT        S.47
         TSR         ISECYL,CYL.21
         TSR         ISECTR,SCT.21
         JMS         R4,READ
CYL.21:  WORD        0
SCT.21:  WORD        0
         WORD        SECSP1
         SUB         #1,C.1
         TSR         C,1,MQ
         CLR         C.1
         DIV         #51.,C.1
         MPY         #14.,R2
         TSR         MQ,R2
         TSR         SECSP1(R2),CYL.22
         TSR         SECSP1+2(R2),SCT.22
         TST         CYL.22
```

```
        BRGE      NXTMOD
        JMP       S.52
NXTMOD: JMS       R4,READ
CYL.22: WORD      0
SCT.22: WORD      0
        WORD      SECSP2
        TSR       C.1,MQ
        MPY       #5,C.1
        TSR       MQ,R2
        BTSR      #48,,SECSP2+4(R2)
        TSR       CYL.22,CYL.23
        TSR       SCT.22,SCT.23
        JMS       R4,WRITE
CYL.23: WORD      0
SCT.23: WORD      0
        WORD      SECSP2
        JMP       S.48
;***************************************************************************
;    THIS SEGMENT DELETES THE AUTHORITY AUGMENTING SECU ITY CODE AS       *
;    REQUESTED BY THE DBA.                                                 *
;*********************************************************   *************
S.51:   JMS       R7,GET.3
C.2:    WORD      0
        CMP       C.2,#1
        BRLT      S.47
        CMP       C.2,#450.
        BRGT      S.47
        TSR       ASECYL,CYL.24
        TSR       ASECTR,SCT.24
        JMS       R4,READ
CYL.24: WORD      0
SCT.24: WORD      0
        WORD      SECSP1
        SUB       #1,C.2
        TSR       C.2,MQ
        CLR       C.2
        DIV       #25,,C.2
        MPY       #14,,R2
        TSR       MQ,R2
        TSR       SECSP1(R2),CYL.25
        TSR       SECSP1+2(R2),SCT.25
        TST       CYL.25
        BRLT      S.52
        JMS       R4,READ
CYL.25: WORD      0
SCT.25: WORD      0
        WORD      SECSP2
        TSR       C.2,MQ
        MPY       #10.,C.2
        TSR       MQ,R2
        TST       SECSP2(R2)
        BRLT      S.52
        TSR       SECSP2(R2),CYL.26
        TSR       #-1,SECSP2(R2)
        TSR       SECSP2+2(R2),DVO.4
```

```
            TSR         SECSP2+4(R2),DVO.5
            JMS         R7,DVORBL
DVO.4:      WORD        0
DVO.5:      WORD        0
DVO.6:      WORD        0
            TSR         DVO.6,SCT.26
            JMS         R7,RELSEC
CYL.26:     WORD        0
SCT.26:     WORD        0
            TSR         CYL.25,CYL.27
            TSR         SCT.25,SCT.27
            JMS         R4,WRITE
CYL.27:     WORD        0
SCT.27:     WORD        0
            WORD        SECSP2
            JMP         S.48
S.52:       SWRITE      TTY,SME.12
W12:        WAITR       TTY,W12
            JMP         S.48
S.53:       JMS         R7,GET
            BCMP        CH,#40
            BRZS        S.53
            CLR         R6
            BTSR        CH,R6
            BCMP        CH,#61
            BRZS        S.57
            BCMP        CH,#62
            BRZC        S.54
            JMP         S.60
S.54:       BCMP        CH,#63
            BRZC        S.55
            JMP         S.60
S.55:       BCMP        CH,#64
            BRZS        S.56
            JMP         S.47
S.56:       JMP         S.66
;**************************************************  ************
;    THIS SEGMENT ENTERS A NEW FIRST SECURITY CODE OR M  IFIES AN     *
;    EXISTING ONE AS REQUESTED BY THE DBA                             *
;**************************************************  ************
S.57:       JMS         R7,GET.3
C.3:        WORD        0
            CMP         C.3,#1
            BRGE        S.E.1
            JMP         S.47
S.E.1:      CMP         C.3,#918.
            BRLE        S.E.2
            JMP         S.47
S.E.2:      TSR         ISECYL,CYL.28
            TSR         ISECTR,SCT.28
            JMS         R4,READ
CYL.28:     WORD        0
SCT.28:     WORD        0
            WORD        SECSP1
            SUB         #1,C.3
```

```
            TSR       C.3,MQ
            CLR       C.3
            DIV       #51.,C.3
            MPY       #14.,R2
            TSR       MQ,R2
            TST       SECSP1(R2)
            BPLT      S.E.5
            TSR       SECSP1(R2),S.E.3
            TSR       SECSP1+2(R2),S.E.4
            JMS       R4,READ
S.E.3:      WORD      0
S.E.4:      WORD      0
            WORD      SECSP2
            BRN       S.59
S.E.5:      JMS       R7,ALOCTS
CYL.29:     WORD      0
SCT.29:     WORD      0
            TSR       CYL.29,SECSP1(R2)
            TSR       SCT.29,SECSP1+2(R2)
            TSR       #4,R3
            TSR       #51.,R4
S.58:       BTSR      #48.,SECSP2(R3)
            ADD       #5,R3
            DEC       R4
            BR7C      S.58
            TSR       #SECSP1+4,WOR.1
            ADD       R2,WOR.1
            JMS       R7,GENWOR
WOR.1:      WORD      0
S.59:       TSR       #SECSP1+4,WOR.2
            ADD       R2,WOR.2
            JMS       R7,GET.10
SE.1:       .=        .+10.
            TSR       #SE.1,WOR.3
            TSR       #SE.1,WOR.4
            JMS       R7,WORBLE
WOR.2:      WORD      0
WOR.3:      WORD      0
            JMS       R7,GIVSEC
WOR.4:      WORD      0
WOR.5:      .=        .+4
            TSR       C.3,MQ
            MPY       #5,C.3
            TSR       MQ,R3
            BCLR      SECSP2+4(R3)
            BTSR      WOR.5,SECSP2(R3)
            BTSR      WOR.5+1,SECSP2+1(R3)
            BTSR      WOR.5+2,SECSP2+2(R3)
            BTSR      WOR.5+3,SECSP2+3(R3)
            TSR       SECSP1(R2),CYL.30
            TSR       SECSP1+2(R2),SCT.30
            JMS       R4,WRITE
CYL.30:     WORD      0
SCT.30:     WORD      0
```

```
            WORD        SECSP2
            TSR         ISECYL,CYL.31
            TSR         ISECTR,SCT.31
            JMS         R4,WRITE
CYL.31:     WORD        0
SCT.31:     WORD        0
            WORD        SECSP1
            JMP         S.48
;***********************************************************************
;     THIS SEGMENT ENTERS A NEW AUTHORITY AUGMENTING SECURITY CODE OR *
;     MODIFIES AN EXISTING ONE WITH IT'S ASSOCIATED VECTOR KEPT INTACT*
;***********************************************************************
S.60:       JMS         R7,GET.3
C.4:        WORD        0
            CMP         C.4,#1
            BRGE        S.E.6
            JMP         S.47
S.E.6:      CMP         C.4,#450.
            BRLE        S.E.7
            JMP         S.47
S.E.7:      TSR         ASECYL,CYL.32
            TSR         ASECTR,SCT.32
            JMS         R4,READ
CYL.32:     WORD        0
SCT.32:     WORD        0
            WORD        SECSP1
            SUB         #1,C.4
            TSR         C.4,MQ
            CLR         C.4
            DIV         #25.,C.4
            MPY         #14.,R2
            TSR         MQ,R2
            TST         SECSP1(R2)
            BRLT        S.E.10
            TSR         SECSP1(R2),S.E.8
            TSR         SECSP1+2(R2),S.E.9
            JMS         R4,READ
S.E.8:      WORD        0
S.E.9:      WORD        0
            WORD        SECSP2
            BRN         S.62
S.E.10:     JMS         R7,ALOCTS
CYL.33:     WORD        0
SCT.33:     WORD        0
            TSR         CYL.33,SECSP1(R2)
            TSR         SCT.33,SECSP1+2(R2)
            CLR         R3
            TSR         #25.,R4
S.61:       TSR         #-1,SECSP2(R3)
            ADD         #10.,R3
            DEC         R4
            BRZC        S.61
            TSR         #SECSP1+4,WOR.6
            ADD         R2,WOR.6
            JMS         R7,GENWOR
```

```
WOR.6:    WORD    0
S.62:     TSR     #SECSP1+4.WOR.7
          ADD     R2,WOR.7
          JMS     R7,GET.10
SE.2:     .=      .+10.
          TSR     #SE.2.WOR.8
          TSR     #SE.2.WOR.9
          JMS     R7,WORBLE
WOR.7:    WORD    0
WOR.8:    WORD    0
          JMS     R7,GIVSEC
WOR.9:    WORD    0
WOR.10:   .=      .+4
          TSR     C.4,MQ
          MPY     #10..C.4
          TSR     MQ,R3
          BTSR    WOR.10.SECSP2+6(R3)
          BTSR    WOR.10+1.SECSP2+7(R3)
          BTSR    WOR.10+2.SECSP2+8.(R3)
          BTSR    WOR.10+3.SECSP2+9.(R3)
          TSR     SECSP1(R2),CYL.36
          TSR     SECSP1+2(R2),SCT.36
          TSR     ASECYL.CYL.34
          TSR     ASECTR.SCT.34
          JMS     R4,WRITE
CYL.34:   WORD    0
SCT.34:   WORD    0
          WORD    SECSP1
          TST     SECSP2(R3)
          BRLT    S.E.13
          TSR     CYL.36.S.E.11
          TSR     SCT.36.S.E.12
          JMS     R4,WRITE
S.E.11:   WORD    0
S.E.12:   WORD    0
          WORD    SECSP2
          BRN     S.64
S.E.13:   JMS     R7,ALOCTS
CYL.35:   WORD    0
SCT.35:   WORD    0
          TSR     CYL.35.SECSP2(R3)
          TSR     SCT.35.VO.1
          JMS     R7,VORBLE
VO.1:     WORD    0
VO.2:     WORD    0
VO.3:     WORD    0
          TSR     VO.2.SECSP2+2(R3)
          TSR     VO.3.SECSP2+4(R3)
????      TSR     VO.3.SECSP2+4(R3)
          JMS     R4,WRITE
CYL.36:   WORD    0
SCT.36:   WORD    0
          WORD    SECSP2
          CLR     R2
S.63:     CLR     SECSP1(R2)
```

```
        INC     R2
        INC     R2
        CMP     R2,#256.
        BRZC    S.63
        BCMP    R6,#62
        BRZC    S.65
        TSR     CYL.35,CYL.37
        TSR     SCT.35,SCT.37
        JMS     R4,WRITE
CYL.37: WORD    0
SCT.37: WORD    0
        WORD    SECSP1
        JMP     S.48
S.64:   BCMP    R6,#62
        BRZC    S.E.14
        JMP     S.48
S.E.14: TSR     SECSP2(R3),CYL.35
        TSR     SECSP2+2(R3),DVO.7
        TSR     SECSP2+4(R3),DVO.8
        JMS     R7,DVORBL
DVO.7:  WORD    0
DVO.8:  WORD    0
DVO.9:  WORD    0
        TSR     DVO.9,SCT.35
S.65:   JMS     R7,AUTHSC
        WORD    SECSP1
        TSR     CYL.35,CYL.38
        TSR     SCT.35,SCT.38
        JMS     R4,WRITE
CYL.38: WORD    0
SCT.38: WORD    0
        WORD    SECSP1
        JMP     S.AU
;*****************************************************************
;    THIS SEGMENT CHANGES THE AUTHORITY VECTOR ASSOCIATED WITH A   *
;    GIVEN SECURITY CODE WHILE LEAVING THE CODE INTACT             *
;*****************************************************************
S.66:   JMS     R7,GET.3
C.5:    WORD    0
        CMP     C.5,#1
        BRGE    S.E.15
        JMP     S.47
S.E.15: CMP     C.5,#450.
        BRLE    S.E.16
        JMP     S.47
S.E.16: TSR     ASECYL,CYL.39
        TSR     ASECTR,SCT.39
        JMS     R4,READ
CYL.39: WORD    0
SCT.39: WORD    0
        WORD    SECSP1
        SUB     #1,C.5
        TSR     C.5,MQ
        CLR     C.5
        DIV     #25.,C.5
```

```
          MPY       #14.,R2
          TSR       MQ,R2
          TST       SECSP1(R2)
          BRGE      S.67
          JMP       S.47
S.67:     TSR       SECSP1(R2),CYL.40
          TSR       SECSP1+2(R2),SCT.40
          JMS       R4,READ
CYL.40:   WORD      0
SCT.40:   WORD      0
          WORD      SECSP2
          TSR       C.5,MQ
          MPY       #10.,C.5
          TSR       MQ,R3
          TST       SECSP2(R3)
          BRGE      S.E.14
          JMP       S.47
SME.10:   WORD      66.,0,66.
          BYTE      15,12
          BCI       % SPECIFY THE DEVICE CONTAINING%
          BCI       % SECURITY CODES MODIFICATION CARDS%
SME.11:   WORD      44.,0,44.
          BYTE      15,12
          BCI       % ILLEGAL MODIFICATION INSTRUCTION %
          BCI       %OMITTED %
SME.12:   WORD      60.,0,60.
          BYTE      15,12
          BCI       % DELETING AN EMPTY CODE.%
          BCI       %NO ACTION TAKEN,PROGRAM CONTINUES.%
SIN.3:    WORD      8.,0,8.
          .=        .+8.
          END
```

```
;*****************************************************************
;*****************************************************************
;     REMOVE PROGRAM WHICH REMOVES A RELATION FROM THE DATA BASE AS    *
;     REQUESTED BY THE DBA                                             *
;*****************************************************************
;*****************************************************************
          .=         66400
          R1=        %1
          R2=        %2
          R3=        %3
          R4=        %4
          R5=        %5
          R6=        %6
          R7=        %7
          TTY=       1
          KBD=       0
          MD=        177736
          FLAG=      100706
          INPUT=     100710
          NIND=      30626
          RELID=     30366
          KEYRP=     31016
          FMKRP=     27600
          FLNOT=     46156
          FLDID=     35516
          FLDNM=     31516
          FOMAT=     36502
          FDIST=     37466
          FDLISC=    60006
          PMINX=     30506
          PRINXC=    50472
          PRINDX=    40060
          BITMAP=    27740

          BITMAP=    27740
          GET.3=     101104
          PUT=       66000
          EXIT=      76214
REMOVE:   BCLR       FLAG
          BTSR       #1,INPUT
          SWRITE     TTY,RME.3
WRM2:     WAITR      TTY,WRM2
          JMS        R7,GET.3
R.1:      WORD       0
          CMP        R.1,#39.
          BRGT       R.021
          TST        R.1
          BRLE       R.021
          TSR        R.1,R2
          CLR        R3
          BTSR       NIND(R2),R3
          LSL        R2
          TST        RELID(R2)
          BRZS       R.021
          CLR        RELID(R2)
          CLR        KEYRP(R2)
          TSR        FMKRP(R2),R.01
```

```
          JMS       R5,FLNGT
          WORD      R.01
          WORD      R.02
          ADD       #3,R.02
          TSR       R.02,MQ
          MPY       R3,R.01
          TSR       MQ,R.01
          TSR       #372,R6
          CLR       R3
R.2:      BCMP      R.1,FLDID(R3)
          BRZS      R.3
          ADD       #2,R3
          DEC       R6
          BRZC      R.2
R.021:    RESET
          SWRITE    TTY,RME.1
RW1:      WAITR     TTY,RW1
          JMP       EXIT
R.3:      TSR       R3,R5
          TSR       #1,R4
          ADD       #2,R3
R.4:      BCMP      R.1,FLDID(R3)
          BRZC      R.5
          INC       R4
          ADD       #2,R3
          BRN       R.4
R.5:      TSR       FLDID(R3),FLDID(R5)
          TSR       FOMAT(R3),FOMAT(R5)
          LSL       R3
          LSL       R3
          LSL       R5
          LSL       R5
          TSR       FLDNM(R3),FLDNM(R5)
          TSR       FLDNM+2(R3),FLDNM+2(R5)
          TSR       FLDNM+4(R3),FLDNM+4(R5)
          TSR       FLDNM+6(R3),FLDNM+6(R5)
          ASR       R3
          ASR       R3
          ASR       R3
          ASR       R5
          ASR       R5
          ASR       R5
          BTSR      FDIST(R3),FDIST(R5)
          INC       R3
          INC       R5
          CMP       R3,FDLISC
          BRGE      R.6
          LSL       R3
          LSL       R5
          BRN       R.5
R.6:      CMP       R5,FDLISC
          BRGE      R.61
          LSL       R5
          CLR       FLDID(R5)
          ASR       R5
```

```
            INC        R5
            BRN        R.6
R.61:       SUB        R4,FDLISC
            TSR        PMINX(R2),R3
            ASR        R2
            ADD        R.02,R3
            SUB        #3,R3
            CLR        R4
            BTSR       NIND(R2),R4
            LSL        R2
R.071:      BTSR       PRINDX(R3),R.072
            JMS        R7,RELCYL
R.072:      WORD       0
            ADD        R.02,R3
            DEC        R4
            BRGT       R.071
            TSR        PMINX(R2),R3
            TSR        R3,R6
            SUB        R.01,PRINXC
            TSR        R.01,R5
            ADD        R3,R5
R.7:        BTSR       (R5)+,(R3)+
            CMP        R3,PRINXC
            BRGE       R.8
            BRN        R.7
R.8:        TSR        #2,R2
R.9:        TST        RELID(R2)
            BRZS       R.10
            CMP        R6,PMINX(R2)
            BRGT       R.10
            SUB        R.01,PMINX(R2)
R.10:       ADD        #2,R2
            CMP        R2,#80.
            BRLT       R.9
            JMP        PUT
R.01:       WORD       0
R.02:       WORD       0
RME.1:      WORD       52.,0,52.
            BYTE       15,12
            BCI        % DELETING A NON EXISTING%
            BCI        % RELATION,COMMAND IGNORED %
RME.3:      WORD       66.,0,66.
            BYTE       15,12
            BCI        % SPECIFY THE RELATION NO. OF%
            BCI        % RELATION TO BE REMOVED %
            BCI        %IN 3 DIGITS %
;*****************************************************************
;     THIS ROUTINE IS USED TO RELEASE THE CYLINDERS VACATED BY THE    *
;     RELATION WHICH IS REMOVED FROM THE DATA BASE                    *
;*****************************************************************
RELCYL:     TSR        R2,-(R1)
            TSR        R3,-(R1)
            TSR        R4,-(R1)
            TSR        (R7)+,R2
            TST        R2
```

```
         BRLT      R.20
         TSR       #24.,R3
R.15:    CMP       R2,#16.
         BRLT      R.17
         SUB       #16.,R2
         SUB       #2,R3
         TST       R3
         BRLT      R.20
         BRN       R.15
R.16:    WORD      0
R.17:    TSR       #1,R.16
R.18:    TST       R2
         BRZS      R.19
         DEC       R2
         ASL       R.16
         BRN       R.18
R.19:    CLR       R.16,BITMAP(R3)
         TSR       (R1)+,R4
         TSR       (R1)+,R3
         TSR       (R1)+,R2
         RTS       R7
R.20:    SWRITE    TTY,RME.2
RW2:     WAITR     TTY,RW2
         STOP
         RME.2:    WORD 40.,0,40.
         BYTE      15,12
         BCI       % CYLINDER TO BE RELEASED OUT%
         BCI       % OF RANGE %
         END
```

```
;*******************************************************************
;*******************************************************************
;    PUT ROUTINE WHICH PUTS RELATION DIRECTORY,FIELD LIST & PRIMARY  *
;    INDEX TABLE & OTHER VARIABLE DATA FROM CORE INTO DISK.          *
;*******************************************************************
;*******************************************************************
        .=          66000
        R1=         %1
        R2=         %2
        R3=         %3
        R4=         %4
        R5=         %5
        R6=         %6
        R7=         %7
        ND=         26146
        ND1=        26150
        WRITE=      22066
        EXIT=       76214
PUT:    TSR         ND,R2
        JMS         R4,WRITE
        WORD        201.,101.,50400
        JMS         R4,WRITE
        WORD        201.,138.,60000
        TSR         ND1,R3
        TSR         #25.,R5
P1:     TSR         (R3)+,R4
        TSR         (R3)+,STR10
        TSR         (R3)+,CYL10
P2:     TSR         (R3)+,SCT10
        JMS         R4,WRITE
CYL10:  WORD        0
SCT10:  WORD        0
STR10:  WORD        0
        ADD         #400,STR10
        DEC         R5
        BR7C        P3
        JMP         EXIT
P3:     DEC         R4
        BRGT        P2
        DEC         R2
        BRGT        P1
        JMP         EXIT
        END
```